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BRITISH COLUMBIA BUREAU OF MINES

BULLETIN No. 1, 1917

PRELIMINARY REVIEW AND ESTIMATE

OF

MINERAL PRODUCTION, 1916

BY

WM. FLEET ROBERTSON, Provincial Mineralogist

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

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To the Hon. William Sloan,

Minister of Mines, British Columbia.

Sir,—I beg to submit herewith a preliminary estimate of the mineral production of the Province for the year 1916, together with some notes on the progress of the mining and metallurgical industries during the year just closed; the information herein presented is, of course, subject to revision.

The object of this preliminary estimate and review is to give, as promptly as possible after the close of the year, an approximate statement of the condition of the mining interests, without waiting until the official returns from the mines have been received, and without the delay that of necessity must take place in carefully preparing the detailed information given each year in the Annual Report of the Minister of Mines.

I have the honour to be,
Sir,
Your obedient servant,

WILLIAM FLEET ROBERTSON,
Provincial Mineralogist.

Bureau of Mines, Victoria, B.C.,
January 15th, 1917.

PRELIMINARY REVIEW AND ESTIMATE

—OF—

MINERAL PRODUCTION FOR THE YEAR 1916

THIS bulletin has been prepared before the receipt of the official reports for the year 1916 of the Gold Commissioners and Mining Recorders of the Province, and the customary returns of mineral production annually made by managers of mines and reduction works; consequently, it must necessarily be regarded as being simply a preliminary review of the progress of the past year, together with an estimate of the quantities and value of the several mineral products of the Province, which it is believed will prove to be approximately correct.

The accompanying table shows an estimated mineral production during 1916 of a total value of $42,970,553. It will be seen that the total value of the production of 1916 as estimated is some $13,523,047 greater than that of 1915, equivalent to an increase of about 45.9 per cent., which must be regarded as a very encouraging showing, particularly when it is remembered that the output for 1915 was only exceeded in amount by those of the years 1912 and 1913 in the history of mining in the Province. The value of the output in 1916 is larger than that of 1912—the previous record year—by an estimated amount of $10,529,755, or 32.5 per cent.

Had it not been that the Crowsnest Collieries, through a series of mishaps—accompanied by a serious shortage of labour due to the war, followed by a labour strike—was unable to make as large an output as expected and intended, the coal and coke production would have been much greater; but, as it was, there resulted such a shortage of coke as to partially close the copper-smelters, and these in turn compelled the copper-mines to very much curtail their outputs.

But for these untoward circumstances it is certain that the output for 1916 would have approached the $50,000,000 mark, an amount which a few years ago would have been considered visionary.

Taken in the aggregate, our mineral production and development [illegible] year 1916 and the future prospects of the industry are conditions for congratulation at this time.

The continued enormous demand for shells of all sorts for the Allies has continued the great consumption of copper, lead and zinc, and the prices of these metals have continued very high.

In 1914 the average price of copper for the year was 13.6 cents; in 1915 it was 17.3 cents; while in January, 1916, it was 24 cents, and at the close of the year it was 32 cents; the average for the year being 27.2 cents.

The result of this great increase in price of the metal caused those prepared to make an actual production to increase their outputs to the limit, and in many instances enabled them to mine and smelt lower-grade ores which at the normal prices of the metal would not have been possible commercially.

The output of copper for the year 1916 is estimated to have been about 67,757,075 lb., which is about 19 per cent. greater than the previous year. The value of the product was $18,429,924, an increase over last year of $8,594,424, or 87 per cent., and amounts to about 56.3 per cent. of the value of the metallic minerals produced this year.

The rise in the price of lead, while very considerable, has not been so phenomenal; the average price in New York for the year 1915 was 4.567 cents, while for 1916 it was 6.777 cents, the year closing with an average for the month of December of 7.4 cents.

Silver is always associated with lead ores in British Columbia, and the price of this metal also had a great rise; the average price for the year 1915 was 49.68 cents, while for the year 1916 it was 65.66 cents, and for the closing month of the year it was over 75.75 cents.

The combined rises in the prices of lead and silver very greatly helped the silver-lead mines of the Slocan. The Provincial output of lead this past year is estimated to be about 52,242,183 lb., worth $3,186,773, and that of silver was 3,366,205 oz., worth $2,099,838.

Zinc in 1916 sold at an average price in New York of 12.8 cents, while in 1915 the average price was 13.23 cents, which is a seeming decrease; but it must be borne in mind that the normal price of the metal is between 5 and 6 cents, and that the prices of 1915 were due to a "corner" and the shutting-off of the usual sources of supply, so that the present prices must be very acceptable to the producer.

Preliminary figures would indicate that the output of zinc in 1916 was more than two and a half times what it was in 1915, the previous record year. Increased production has been nearly general in all the zinc-producing districts.

The various metals and their production are reviewed in detail later in this report, but it might be noted here that the following table shows the gross value of the metallic minerals recovered in 1916 as being $32,754,353, which represents an increase over the year 1915 of nearly $12,000,000, a percentage increase of about 57.8 per cent., which is certainly a matter of congratulation.

It might further be pointed out that the metalliferous output for 1915 was the greatest in the history of mining in the Province up to that date, being more than 10 per cent. greater than in the former record year of 1912.

There seems to have been an increased production this year in all the metal values except gold.

There are also increases in both the coal and coke productions as compared with the year 1915.

As far as can be ascertained as yet, there is a slight decrease in the item of building materials, due to the cessation of building operations in the larger cities.

As might be expected with a large increase in the amount of metalliferous minerals produced, the tonnage of ore mined in the Province in 1916 also constitutes a record, amounting to about 3,200,000 tons, as compared with 2,690,110 in 1915.

MINERAL PRODUCTION FOR TWO YEARS, 1915-1916.

The following table shows the quantities and value of the several minerals produced in the year 1915, and the estimated production in 1916. It may here be explained that the prices used in calculating the estimated value for 1916 of silver, lead, copper, and zinc are the average prices for the year, as published in *The Engineering and Mining Journal*, New York, less a deduction of 5 per cent. off silver, 10 per cent. off lead, and 15 per cent. off zinc.

	Production, 1915.		Estimated Production, 1916.			
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Gold, placer	....	$ 770,000	....	$ 575,000	....	$195,000
" lode ... oz.	250,021	5,467,934	232,909	4,814,229	....	353,705
Total gold	....	$5,937,934	....	$ 5,389,229	....	$548,705
Silver ... oz.	3,366,506	1,588,991	3,366,205	2,099,838	$ 510,847	....
Lead ... lb.	46,503,590	1,939,200	52,242,183	3,186,773	1,247,573	....
Copper ... "	56,918,405	9,835,500	67,757,075	18,429,924	8,594,424	....
Zinc ... "	12,982,440	1,460,524	33,534,829	3,648,589	2,188,065	....
Total value of metalliferous	....	$20,762,149	....	$32,754,353	$11,992,204	....
Coal ... tons, 2,240 lb.	1,611,129	5,638,952	2,026,672	7,093,352	1,454,400	....
Coke ... "	245,871	1,475,226	270,475	1,622,850	147,624	....
Building materials, etc.	....	1,571,181	....	1,500,000	....	71,181
Total value of production	....	$29,447,508	....	$42,970,555	$13,523,047	....

PRODUCTION OF VARIOUS MINERALS BRIEFLY REVIEWED.

In order to indicate in a general way the sources of the various minerals mined in the Province and to give an idea of some of the conditions that affected their production, and, incidentally, brief information concerning the larger known mineral deposits occurring in British Columbia, the next following comments are submitted.

Gold.

Placer Gold.—The recovery of placer gold for 1916 is estimated at $575,000, of which practically all is obtained in the Cariboo and Cassiar Districts, only about one-tenth of the total coming from the other districts. An approximate apportionment is as follows: From Cariboo District, $180,000; Atlin Division of Cassiar District, $320,000; Stikine and Liard, $30,000; remaining parts of the Province, $45,000. It may be that a larger yield will be shown, but this cannot be definitely stated until after the final returns of the season's operations shall have been received.

While it is expected that the placer-gold output for 1916 will prove to be considerably less than that of the preceding year, it is nevertheless greater than any other year since 1907.

In hydraulic placer-mining, from which about 90 per cent. of the placer gold obtained in British Columbia is derived, it has been pretty well demonstrated that the gold-output is in direct proportion to the number of days in which water was available for piping.

The summer season of 1916 was particularly dry in the northern placer-fields, with a consequent small supply of water for mining, which accounts for the lessened placer-gold output.

The Gold Commissioner of Atlin, the principal placer camp, writes regarding the smaller output: "For this decrease in output various causes may be advanced, but the principal one was the shortage of water, and another was the scarcity of labour."

The scarcity of labour was due to the number of men who had left the district with the recruiting officer to enlist for active service abroad.

The enormously increased cost of high explosives—due to the war—formerly used for loosening the ground and for "bulldozing," necessitated a curtailment of these.

These same conditions also prevailed in the Cariboo District, producing "the quietest season that this district has experienced for a long time."

These adverse conditions are not permanent and will be gradually removed; the mining companies are becoming impressed with the advisability of putting in reservoirs for the conservation of the spring freshet water, and such works are now under way, so that the future will see the industry less dependent on a favourable or rainy season.

The supply of labour and explosives will right themselves as soon as our world becomes normal again.

Lode Gold.—The quantity of lode gold produced seems to have been less than in any of the last three years. The output is estimated at $4,814,229, as compared with $5,167,934 in 1915, a decrease of $353,705. The chief reason for this decrease is a decline in the output of the Nelson Division and a lessening of the outputs in the Boundary and Rossland Districts.

One encouraging feature is a large increase from Lillooet Division, which produced 2,625 oz., as compared with 31 oz. in 1915.

The gold production of the various districts is estimated to have been approximately as follows:—

	Oz.
Rossland	129,790
Boundary	82,731
Nelson	7,477
Skeena	4,401
Coast	3,148
Lillooet	2,625
All others	2,737

The production in the Rossland District shows a decrease of 12,805 oz. as compared with 1915, which is accounted for by a decrease in the tonnage shipped.

The Boundary District shows a decrease of 5,039 oz. as compared with 1915, which is accounted for by the lower grade of ore smelted.

The *Nickel Plate* production is expected to have been about the same as the previous year—viz., 38,000 oz. The other properties in this district only contribute small amounts, and of these the *Carmi* and *Dividend-Lakeview* were not operated during the year.

A reduction of about 1,756 oz. is estimated for the Nelson District, due to no production having been made from the *Mother Lode* mine on Sheep creek, which was idle all year. The mine is at present closed and the future plans of the company are not known.

The *Queen* mine, on Sheep creek, made about the same output as the previous year, and it is said that development-work on the lower levels is proving satisfactory in showing the continuation of the ore-shoots.

The *Second Relief*, near Erie, milled more ore than in 1915, and the *Granite-Poorman*, near Nelson, which again entered the list of producers in 1915, is expected to have made a larger output than in the previous year.

The *Yankee Girl* mine, at Ymir, has not shipped any ore for two years, but a low-level tunnel has been driven into the vein and drifting was commenced on it. This work is now progressing and good ore is being found. It is probable that a mill will be erected on the property in the near future.

The production of gold from the Skeena District is practically all from the *Hidden Creek* mine, at Anyox. Less gold was produced than in the previous year, due to the ore being lower in gold-tenure; the ore is primarily a copper ore with very small gold contents; so that fluctuations from year to year are to be expected.

The Coast production shows an increase, due to the larger output from the *Britannia* mine, from 2,490 oz. to 3,148 oz.

The Omineca production comes almost entirely from the *Rocher Déboulé* mine, near Hazelton, which is a new property that only commenced shipping last year. The ore is a high-grade copper ore, carrying low gold and silver values.

In the Bridge River camp of Lillooet Division several gold-quartz properties, all of which were worked in previous years, were reopened and results are said to be very encouraging. The main producers were the *Pioneer*, *Lorne*, and *Coronation*, all of which are equipped with mills.

About 21 per cent. of the gold production of the Province comes from the milling of auriferous quartz ores and 79 per cent. from the smelting of copper ores carrying gold and silver.

Silver.

The quantity of silver produced is estimated to have been about 3,366,205 oz., worth $2,099,838, a decrease from the production of 1915 of 301 oz., but, owing to the higher market value of silver, an increase in value of $510,847. The increase in the market price of silver which commenced in the last months of 1915 continued throughout 1916, the price rising gradually from 56.77 at the beginning of the year to 75.76 cents an ounce at the end of December; the average price for the year was 65.66 cents, as compared with 49.68 in 1915 and 54.81 in 1914.

Approximately the output was the same as in 1915. Increases occurred in Fort Steele, Ainsworth, Omineca, Nelson, Boundary, and the Coast Districts, and decreases occurred in Slocan, Skeena, and Trail Creek Divisions.

The approximate production of the various districts is estimated to have been as follows:—

	Oz.
Slocan and Slocan City	1,608,800
Fort Steele	509,450
Ainsworth	321,476
Boundary	316,128
Skeena	167,379
Trail Creek	132,080
Coast	114,071
Omineca	106,397
All others	90,424
Total	3,366,205

The Slocan District again leads all others in the production of silver, although this year's output of that district was apparently about 200,000 oz. less than in 1915.

The largest producer in the Slocan was again the *Standard*, at Silverton, with an output estimated at about 680,000 oz., followed by the *Rambler-Cariboo* and the *Galena Farm*. The production of the Slocan District would have been considerably greater but for the destruction, early in the year, by fire of the mill where the *Surprise* ore was treated. This mine therefore only made a small output as compared with about 300,000 oz. in 1915. A new mill has been erected and is in operation, so this property will contribute substantially to the silver production in 1917. The total number of shipping mines in the district was about thirty.

The larger production in Ainsworth is due to increased production from the *Highland*, owned by the Consolidated Company, and the *Bluebell*, both of which were operated continuously throughout the year.

In East Kootenay the main production is from the *Sullivan* mine, which is expected to have produced about 500,000 oz., which is a slight increase over the 1915 production of 474,253 oz. Small amounts come from the *St. Eugene*, *Monarch*, and *Paradise* mines.

Over 55 per cent. of the Boundary production of silver comes from the Granby Company's mines at Phoenix. Other mines contributing are the *Mother Lode*, *Sally*, *Horn Silver*, and *Union*.

The silver production from Trail Creek comes from the smelting of the gold-copper ores of Rossland camp, which carry about ½ oz. of silver to the ton.

The Skeena production comes almost entirely from the Granby Company's *Hidden Creek* mine, at Anyox.

The Omineca production shows an increase of about 34 per cent. as compared with the previous year, largely due to an increased production from the *Silver Standard* mine, at Hazelton.

The Coast production of silver comes from the smelting of copper ores carrying low values in the precious metals. As a larger tonnage of copper ore was smelted, the silver-output shows an increase.

About 82.5 per cent. of the total Provincial output of silver comes from the treatment of silver-lead-zinc ores and the balance mainly from the smelting of gold-copper ores carrying silver.

Lead.

The total amount of lead produced in 1916 is estimated to have been 52,242,183 lb., valued at $3,186,773. This represents, as compared with the previous year, an increase in quantity of 5,738,593 lb., and in value of $1,247,573. This is the greatest production of lead since the year 1913, and the value of the 1916 output, by reason of the high market price for lead, is the greatest in the history of mining in the Province. The previous record year was in 1900, when 63,358,621 lb. was produced, valued at $2,691,887.

The market price of lead remained at a high mark all year; the average price for January, 1916, was 5.921 cents, the December price 7.51 cents, and the average 6.858 cents a pound.

The following table shows the estimated production of lead according to districts:—

	Lb.
Fort Steele	26,782,053
Slocan	14,434,585
Ainsworth	8,689,839
Nelson	1,176,780
Windermere-Golden	616,000
Omineca	254,983
All others	287,943
Total	52,242,183

The large production in Fort Steele Division comes almost entirely from the *Sullivan* mine, owned by the Consolidated Company; the 1916 output of the mine was nearly the same as in 1915.

The figures for Slocan show a slight decrease from the output of the previous year, due principally to the temporary withdrawal of the *Surprise* from the shipping-list. The heaviest contributor was again the *Standard*, at Silverton, with an output of about 6,500,000 lb., followed by the *Galena Farm* with 1,900,000 lb., the *Rambler-Cariboo* with 1,300,000 lb., and the *Slocan Star* with over 1,000,000 lb.

The production from Ainsworth shows an increase of 5,253,655 lb., or 153 per cent. This large increase was due to the return of the *Highland* to the shipping-list with a production estimated at 2,580,000 lb., and to the operation of the *Bluebell* mine for a full year instead of one-half year as in 1915, with a corresponding doubling of production or nearly so.

Nelson Division produced about 200,000 lb. more lead than in 1915. The principal shipper is the *Emerald*, but the 1916 production was augmented by shipments from the *H.B.*, *Molly Gibson*, and *Spokane* mines.

The Windermere-Golden District produced about three times as much lead as in 1915. The *Monarch*, at Field, made about the same output as in 1915, but a number of properties were worked in the Windermere District which had been idle for some years. Of these, the *Paradise* was the most important and the *Lead Queen* the next biggest shipper. In all, seven or eight properties are reported to have shipped from the Windermere Division.

The Omineca production of lead was about the same as in 1915, and the greater portion of it came from the *Silver Standard* mine, at Hazelton, which produced 193,000 lb. of lead.

Copper.

The amount of copper estimated to have been produced during the year 1916 is the largest in the history of copper-mining in the Province, amounting as it does to 67,757,075 lb., worth $18,429,924; the highest previous production was made in 1915.

The production as estimated for 1916, compared with that of the previous year, shows an increase in quantity of 10,838,670 lb. and in value of $8,594,424, or 87.4 per cent.

Owing to the heavy demand for war purposes, principally for brass to be used in shells, the market price of copper increased steadily during the year. The year opened with copper at about 24 cents a pound in the New York market, and at the end of December it was 31.9 cents; the average price for the year was 27.2 cents, as compared with an average price of 13.6 cents in 1914 and 17.275 cents in 1915. This higher market value of the metal assisted materially in raising the value of the copper produced, thereby greatly stimulating production.

The large increase in quantity of copper produced this year is due to a greatly increased production from the Granby Company's *Hidden Creek* mine, at Anyox, on

Observatory inlet, to a return to a nearly normal output from the Boundary District, and to a nearly doubled production from the *Britannia* mine.

The Rossland District is expected to have made a slightly decreased output, due to a smaller tonnage from the Rossland mines, which, in turn, was due to a coke shortage preventing the Trail smelter from operating throughout the year at full capacity.

The copper production from the several districts is expected to have been approximately as follows:—

	Lb.
Skeena Division	26,056,005
Southern Coast District	18,853,916
Boundary District	16,618,284
Trail Creek Division	4,081,500
Omineca Division	1,262,730
All other districts	884,640
Total	67,757,075

The big mine and smelter of the Granby Company at Anyox were operated continuously throughout the year, and the tonnage treated was gradually increased, until, at the end of the year, 2,200 tons a day was being smelted. The Granby Company this year produced from its mines in Skeena and Boundary 59 per cent. of the Province's copper production.

Another important producer of copper in the northern portion of the Province is the *Rocher Déboulé* mine, near Hazelton. The production of this mine in 1916 was about 10,000 tons, containing over 1,250,000 lb. copper.

In the Boundary District the Granby Company's mines at Phoenix and smelter at Grand Forks were operated to nearly full capacity throughout the year, but were slightly handicapped by the coke shortage. A larger tonnage of ore was mined and smelted than in 1915, but the production of copper was slightly less. This was due to handling a considerable tonnage of ore from which a recovery of only 10 lb. to the ton was made, which, owing to the high market price of copper, it was possible to handle at a profit and thereby increase the ore reserve of the mine. A lot of this low-grade material was handled by the electric shovel, and the cost of mining and handling was therefore very low.

The British Columbia Copper Company operated steadily throughout the year and made a larger production than in 1915, although this company was also affected by the coke shortage and for part of the year could only run one furnace.

The *Britannia* mine had a very successful year, the tonnage of ore mined and milled being about 400,000 tons, containing 18,000,000 lb. copper, 98,000 oz. silver, and 800 oz. gold. The ore reserves at this mine are large—claimed to be about 17,000,000 tons—and it is expected the yearly tonnage treated will increase still further, as the ultimate plans of the company are to have milling capacity to handle 4,000 tons a day.

The copper-mines on Texada island are expected to have made a larger output than in 1914; the most important producer is again the *Marble Bay*.

More small shipments of copper ore were made from Vancouver Island and along the Coast than in 1915. The high price of copper has stimulated the work of developing copper-showings on the Coast, and while this has not resulted in any great quantity of ore being shipped in 1916, it is likely that a considerable increase of production will take place in 1917.

The only production of copper in the Nelson Division was from the *Eureka* mine, but the reopening of the old *Silver King* mine about the end of the year may assist copper production from this Division in 1917.

Copper-mining is now the most important form of mining in the Province, and this year the value of the copper mined exceeded the total value of all other metalliferous minerals, and also exceeded the combined value of coal and coke production. It formed 56.3 per cent. of the total value of the metalliferous mines and 42 per cent. of the total mineral production. In the working of the large, low-grade copper-deposits and the subsequent smelting of the ores produced, a great number of men are employed and a large proportion of the money value is retained in the country in the payment of wages and purchase of supplies.

All the copper ores carry small amounts of the precious metals, and therefore any increase in the copper production also increases the output of gold and silver. The high price of copper during the past year has stimulated prospecting and the development of copper claims, and there is no doubt that the Provincial output will steadily grow in future years.

The most important metallurgical development in connection with copper-mining during the year 1916 was the establishment of a copper-refinery at the Trail smelter. Until this year all copper produced in the Province was shipped to Eastern points as blister-copper and there refined, but with a start at refining having been made, it may be expected that an increasing amount of the copper-output will be refined in the Province.

The plant at Trail has a capacity of 10 tons of refined copper a day, but is being increased to 15 tons a day; it treats blister-copper from the Trail smelter and part of the blister-copper produced at the Greenwood smelter of the British Columbia Copper Company.

The smelting plant at Ladysmith owned by the Tyee Copper Company, which has lain idle since 1911, was sold near the end of the year, but no announcement has yet been made as to who has bought it. It is said that the purchasers intend to enlarge the smelter, equip it with converters, and possibly to erect a copper-refinery to refine the blister-copper produced. It is said that a supply of ore to keep the smelter going steadily has been secured or is controlled, and in addition the smelter will be in the field for custom ore.

Zinc.

The quantity of zinc estimated to have been produced in 1916 amounted to 33,534,829 lb., having a value of $3,648,589. These figures are very much higher than those of 1915, which was itself a record year. While the years 1915 and 1916 show great increases in production as compared with previous years, the very high price of zinc in those two years makes the value of the production still higher in comparison with previous years.

The following table illustrates the great increase from 1914 onwards:—

	Lb.	Value.
1913	6,758,768	$ 324,421
1914	7,866,467	346,125
1915	12,982,440	1,460,524
1916	33,534,829	3,648,589

It is interesting to note that in 1916 the value of the zinc production was greater by $461,816 than the value of the lead produced, which latter itself was a record.

The market price of zinc dropped somewhat in 1916 as compared with 1915, but it still remained over twice the normal before-the-war price and still remained sufficiently high to greatly stimulate production. The average price for the year was 12.804 cents and the average for the month of December 10.66 cents.

An important event during the year was the commencement, in the spring, of the production of refined zinc at the new electrolytic zinc plant at the Trail smelter. This plant, which has a capacity of 25 tons a day of refined zinc, uses a new process which takes in the raw ore and turns out refined zinc. This is the first time that zinc ore has ever been treated in a commercial plant in British Columbia, and therefore adds a new industry to those which centre around mining. The plant was designed and built to treat ore from the Consolidated Company's *Sullivan* mine, but towards the end of the year some zinc concentrate was bought from the *Lucky Jim* mine and treated.

The following table shows the districts from which the zinc production of the Province is made:—

	Lb.
Slocan	18,050,887
Fort Steele	12,000,000
Nelson	2,800,000
Windermere-Golden	312,000
Ainsworth	104,325
Omineca	168,616
Total	33,534,829

In the Slocan District the heaviest shipper is the *Standard* with approximately 9,530,000 lb., followed by the *Slocan Star*, the *Galena Farm* with about 2,500,000 lb., the *Lucky Jim*, and the *Rambler-Cariboo*. The Slocan production consists largely of concentrates, which is all shipped to United States smelters for treatment.

The Fort Steele production comes entirely from the *Sullivan* mine; the ore is shipped to the Trail electrolytic refinery.

The Nelson production is a zinc-carbonate ore shipped to United States smelters for treatment, and comes from the *H.B.* group of mines, near Salmo.

The output of zinc from Windermere-Golden is all made by the *Monarch* mine, at Field, and is produced as a concentrate.

For the first time a production of zinc was made from the Omineca Division. This came from the *Silver Standard* mine, and was hand-sorted ore averaging about 40 per cent. zinc and 60 oz. silver.

Other Minerals.

No iron ore has been actually shipped during the past year, but some development and prospecting has again begun, stimulated by the demand for iron and steel which has been emphasized by the war having monopolized all the usual outside sources of supply, while the high freight rates have only made the lack of local production more pronounced.

The consequent strong agitation in favour of a local iron-smelting plant and the hope that such may materialize in the near future has led the owners of iron claims adjacent to the Coast to expect a market for their ores.

As is well known, there is on the Coast, in the aggregate, an adequate supply of magnetite-iron ore quite sufficiently free from impurities as to be within the "Bessemer limit."

A small quantity of crude platinum is obtained from placer-mining operations in the Similkameen District, but, although such platinum occurs with the placer gold in the Dease Lake country, no effort has been made this last year to save any appreciable amount.

The urgent demand for war purposes for antimony and molybdenum caused the Dominion Government Munitions Resources Commission to detail two ex-members of the Geological Survey, W. F. Ferrier and J. C. Gwillim, to spend the best part of the season in British Columbia in search of any available ores of these metals.

It has not yet been learned what success attended these efforts as far as antimony is concerned, though it is understood a small shipment was made from Three Forks. The drop in the price of the metal from 40 cents to 12 to 14 cents later in the season discouraged production.

As regards molybdenite ores, Mr. Gwillim reports that he has secured the following shipments:—

Molly mine ..... 15 to 20 tons ore running about 12 per cent. MoS_2.
Index mine, Texas Creek, 9 tons ore running about 16 per cent. MoS_2.
Alice Arm ....383 tons ore running about 2 per cent. MoS_2.
Keremeos .... 2 tons ore running about 30 per cent. MoS_2.

It is understood that these ores were shipped to Ottawa to be there concentrated in the Government mill up to the required commercial grade of about 85 per cent. MoS_2, for which payment is to be made at the rate of approximately $20 a unit, less a nominal charge for concentrating.

At the *Molly*, the *Index*, and at Alice arm there are considerable tonnages of lower-grade ore, and if these mines were equipped with small but suitable concentrating-mills a regular production could be maintained.

Structural Materials, etc.

The output during 1916 of all structural materials, such as cement, lime, building-stone, sand and gravel, brick, and other clay products, will probably show a slight decrease from that of previous years. This is due to the cessation of building operation, especially in the Coast cities, which commenced to decline early in 1914 and was almost entirely suspended during 1915; to a large extent this depression in the building trades is owing to the conditions brought on by the war.

The output for 1916 is estimated at $1,500,000, as against $1,571,181 in the preceding year $2,852,917 in 1914, and $3,398,100 in 1913.

During the years 1915 and 1916 a large amount of rough building-stone in the shape of large granite blocks was used in the building of the Government breakwater and piers at the Outer Wharf, Victoria. The outputs of Portland cement, sand, gravel, and of brick are expected to have been about the same as in the previous year.

As far as can be learned, none of the gypsum companies or marble-quarries made any appreciable output.

About 90 per cent. of the output of structural materials is made in the Coast District, and practically all of this is used in the Coast cities.

Coal and Coke.

It is estimated that the gross production of coal was 2,495,893 long tons, of which 439,221 tons was made into coke, leaving the net production at 2,026,672 tons, These figures show an increase, as compared with 1915, of 513,313 tons gross and of 415,543 tons net. The quantity of coke made was about 270,475 tons, which is an increase of about 24,604 tons as compared with 1915. For purposes of comparison the following table is shown:—

		Est. 1916.	1915.	1914.	1913.	1912.	1911.
Coal, gross.........tons, 2,240 lb.		2,495,893	1,972,580	2,166,428	2,570,760	3,025,709	2,297,718
Less made into coke	"	439,221	361,451	355,461	433,277	396,905	104,656
Coal, net.......	"	2,026,672	1,61[illegible]29	1,810,967	2,137,483	2,628,804	2,193,062
Coke made.........	"	270,475	245,871	234,577	286,045	264,333	66,005

In these figures for 1916 the output for the month of December has had to be estimated, consequently the final figures may vary from them slightly.

Summarizing the Provincial production of coal, the following table shows the estimated output for 1916:—

	Tons of 2,240 lb.
From Vancouver Island collieries	1,510,456
From Nicola and Similkameen collieries	104,548
From Crowsnest District collieries	880,889
Total quantity of coal mined	2,495,893
Less made into coke (calculated)	439,221
Net quantity of coal produced	2,026,672

In addition to the above net production of coal, there was made the coke production shown in the following table:—

	Tons of 2,240 lb.
From Vancouver Island collieries	28,044
From Nicola and Similkameen collieries	*Nil*
From Crowsnest District collieries	242,431
Total	270,475

As will be seen by the above figures, the net coal production this year is expected to be some 415,543 tons (2,240 lb.) greater than it was in 1915, and again about reaches the figures prevailing before the war began.

This output would have been considerably greater had not the Crowsnest Collieries met with a series of misfortunes during the year that interfered with production, and in addition to this there was a serious shortage of labour—partly caused by the heavy enlistment of the younger men—and in the fall there were labour troubles.

All these contributed to occasion a shortage of both coal and coke, when the demand was most keen.

Coke.—The production of coke in 1916 was about 270,475 tons (2,240 lb.), which is 24,004 tons greater than the preceding year, and, with the exception of the year 1913, is greater than any year since 1905.

The high market price of the metals, particularly copper, kept the copper-smelting plants, both of the Interior and the Coast, running to full capacity, or as the coke-supply would permit.

Of this gross coke production, 242,431 tons was made by the Crow's Nest Pass Coal Company in East Kootenay, and the remaining 28,044 tons was made by the Canadian Collieries at Comox, V.I.

VANCOUVER ISLAND COLLIERIES.

The Vancouver Island collieries made a gross output of 1,510,000 tons of coal, or about 489,000 tons more than in 1915.

Western Fuel Co.—This company mined this past year about 560,000 tons of coal, an increase over the previous year of about 144,000 tons.

The Nanaimo Colliery, in the City of Nanaimo, is entered by No. 1 or Esplanade shaft, which is connected by underground workings with a shaft on Protection island and also on Newcastle island. The workings are at a depth of from 600 to 1,200 feet, and are very extensive, including a large submarine area. On the North side both the Douglas and Newcastle seams are operated; on the South side only the Douglas or Upper seam is worked. This property has been in operation since 1881, and is still the largest producing coal-mine in the Province.

The Reserve Colliery is situated about five miles from Nanaimo; the Douglas seam is reached through two shafts 950 feet in depth. This property became a producer in 1914; development has been much retarded owing to faulted and much-disturbed condition of the seam. It gives promise of being a large producer in 1917.

Canadian Collieries (Dunsmuir), Ltd.—This company operates two collieries—Comox, situated at Cumberland, seventy miles north of Nanaimo, and Wellington-Extension, at Extension, six miles south-west of Nanaimo.

The mines of the Comox Colliery are situated around Cumberland, and are connected by a standard-gauge railway with the seaboard at Union bay, where are situated the loading-piers, a coal-washery, and a battery of 100 coke-ovens.

The mines operated during the year are Nos. 4 and 7 slopes and No. 6 shaft.

Little change has been made at the colliery during the year. The larger demand for bunker coal during the year is reflected in the output of 453,122 tons, an increase of 192,000 tons over the previous year.

The mines of the Wellington-Extension Colliery are situated around Extension, and are connected by a standard-gauge railway with tide-water, and the E. & N. Railway at Ladysmith, where a coal-washery, bunkers, and loading-piers are situated.

Four mines were operated during the year, Nos. 1, 2, and 3, entered by a tunnel 5,000 feet in length, and No. 4, entered by shaft. The output for the year was 202,377 tons, an increase of about 93,000 tons over that of 1915.

Pacific Coast Coal Mines, Ltd.—This company operated the South Wellington and Morden Collieries; these are situated about six miles south of Nanaimo, and produced during the past year 155,000 tons, an increase of 25,000 tons over the previous year.

A new slope was driven at the Morden shaft, and the shaft-bottom reconstructed at a point 13 feet lower than the old temporary shaft-bottom; this improvement should make possible a larger output from this mine during the present year.

No work was done during the year on the Suquash Colliery, owned by this company, and situated on the northern part of Vancouver Island.

Vancouver-Nanaimo Coal Mining Co.—This company operates the New East Wellington Colliery, situated two miles west of Nanaimo, and is working the Old Wellington seam. The output for the past year was 79,000 tons, an increase of 31,000 tons over that of 1915, reflecting, in common with other companies on Vancouver Island, the general improvement in the business over the previous year.

NICOLA AND SIMILKAMEEN COALFIELDS.

These coalfields produced in 1916 about 104,000 tons, an increase over the previous year of 5,000 tons. Here, as on Vancouver Island, the demand exceeded the output, which was hampered through shortage of labour.

In the Nicola District two companies produced coal in 1916—viz., Middlesboro Collieries, Limited, and the Inland Coal and Coke Company.

The Middlesboro Colliery is estimated to have produced 49,000 tons during the year, an increase of 1,000 tons over that of 1915.

The Inland Coal and Coke Company produced 30,000 tons, being 4,000 tons less than the previous year.

The Pacific Coast Colliery Company produced no coal during the past year.

Near the end of the year a new organization known as the Merritt Collieries, Limited, took over the holdings of the former Diamond Vale Company, situated at Merritt. This property will likely be a producer in 1917.

In the Similkameen section the Princeton Coal and Land Company, situated at Princeton, was, as in the former year, the only producer; the output is estimated at 24,500 tons, being an increase of 9,000 tons over the previous year.

EAST KOOTENAY COALFIELD.

There were only two companies producing in this field in 1916—the Crow's Nest Pass Coal Company, operating collieries at Coal Creek (Fernie) and at Michel, and the Corbin Coal and Coke Company, with its colliery at Corbin.

There was mined in this district in 1916 some 881,000 tons of coal, an increase of 28,000 tons over 1915.

Of this tonnage, about 365,000 tons was used to make coke and yielded 242,431 tons of that commodity, an increase of 2,000 tons over that of the previous year.

Owing to high prices prevailing for metals, and the consequent activity of the metal-mines and smelters, the demand for coal and coke from this district far exceeded the output.

The early portion of the year gave promise of a much larger production than that realized. The output was seriously affected in the latter half of the year through labour troubles; also an explosion in No. 3 East mine, Michel Colliery, early in August, which cut off the production of this mine for the remainder of the year; and the "bumps" in No. 1 East mine, at Coal Creek, which seriously curtailed the output of that colliery during November and December. In addition to this, operations were seriously hampered by the scarcity of labour, and despite the active demand for coal and coke the district showed but a very small increase over the previous year's operations.

Of the seven mines operated at Coal Creek in 1915: No. 1 East, on the south side of the tipple, was by far the largest producer. This mine was producing 1,500 tons a day up to the early part of November, when a series of "bumps" wrecked the greater portion of the mine, cutting the production to 500 tons a day.

A new fan was installed at No. 1 North mine during the year, and work started on the foundations for a similar installation at No. 1 South mine.

Michel Colliery had three mines in operation during the year, the largest producer being No. 3 East, which was wrecked on August 7th by a disastrous explosion, cutting off production for the remainder of the year.

Shortage of labour interfered with the opening of two new mines in the upper seams on the south side of Michel Creek.

Corbin Coal and Coke Co.—The output of this company for the year was 60,000 tons, an increase of 6,500 tons over that of 1915.

The major portion of this production was from the open-cut or surface workings of No. 3 mine, or "Big Showing."

The operations at this mine, which is reached by a switchback railway, the motive power beng locomotives of the Shay type, are carried on entirely on the surface, the coal being loaded by steam-shovel direct into hopper-bottom or dump cars.

With a view to removing impurities from the coal, a cleaning plant was installed during the year. This plant is situated at Corbin; the coal from the "Big Showing" is hauled in dump-cars to the cleaning plant, passed through the plant and loaded into the railway-cars for shipment.

No. 4 mine was closed down during the early part of last year, but was reopened in August. The operations at this mine are all underground.

MINING DISTRICTS OF BRITISH COLUMBIA.

In order to give a general idea of the mineral deposits, mines, and reduction-works of British Columbia, a summary of these, together with an outline of the chief features of the operations during 1916, will now be presented. As the mining districts are numerous and cover a large area of territory, the information that follows is, necessarily, incomplete, for it is not practicable, in a preliminary review, to give particulars of all that should have notice. The various districts and their respective subdivisions will here be briefly dealt with and in the order in which they usually appear in the Annual Reports of this Department.

CARIBOO DISTRICT.

Three Mining Divisions are usually included under the general head of Cariboo District—namely, the Cariboo, Quesnel, and Omineca Divisions. In the first two Divisions mining operations are restricted almost entirely to placer-mining, there being little, if any, other productive mining, but in the Omineca Division lode-mining is now more important, due to the advent of railway facilities in the southern portion of the Division.

The conditions affecting placer-gold mining in this district have already been referred to under the subhead of "Placer Gold," and, since the conditions were not particularly favourable this past season, it would appear that the gold-output is smaller than it was last year.

Cariboo Mining Division.

The following is an informal preliminary report by the Gold Commissioner of the Cariboo District:—

The past season has undoubtedly been the quietest that this district has experienced for some long time. This without doubt was caused by the general hard times and the diffidence of capitalists with regard to placer-mining in these days of war.

Fewer of the old-time properties were worked than usual; practically no new ventures started and a very small number of individual miners working.

John Hopp as usual worked his properties on Lowhee creek, Stouts gulch, and Mosquito creek, but was considerably handicapped by a very poor water season, caused by an extremely light winter snowfall; heavy summer rains helped to a certain extent, and although a smaller yardage of gravel was worked, I understand that the general average values to the cubic yard were better than ever before.

Lowhee Creek Mine.—After the spring clean-up a vast amount of more or less construction-work was done, getting things into shape for the next season—i.e., building new penstocks and flumes and moving the main pipe-line; also considerable improvements were made to the Ella Lake dam used in connection with this property.

Stouts Gulch Mine.—The pit was extended over the summit and down Lowhee creek as far as possible, good values being obtained; considerable improvements were made with regard to the plant, the entire plant being moved considerably farther down the gulch, thus making it possible to work a large area along the benches on each side of the gulch, which benches carry good values.

Mosquito Creek Mine.—This mine, having but a very small water-supply, is always badly handicapped by a dry season; however, some very rich ground was struck, which more or less made up for the shortness of the season.

Williams Creek.—The old *First of May* claim was worked by a small local company, but, as a vast quantity of barren ground had to be moved to get things into working shape, the summer's work did not much more than pay expenses.

Upper Antler Creek.—The Houser Bros. did considerable work on the two leases owned by them, and, although they did fairly well, they did not do as well as they expected. This winter they intend to do considerable sinking and drifting so as to definitely locate the old channel.

Shepherd Creek, near Eight-mile Lake.—Robert Rees worked the property owned by him with paying results, and it would appear that he owns some very rich ground, which is, however, very hard to get at by the hydraulic method, as he has a very poor water-supply and practically no dump.

Point Claim, Slough Creek.—This property, owned by Loo Gee Wing Company and under the management of Joseph Wendle, was worked as conservatively as heretofore, with good paying results.

Lightning Creek Hydraulic Mining Co.—This company worked its property on Lightning creek with a somewhat smaller staff than usual, and has now installed two hydraulic lifts, which, it is understood, are now working satisfactorily.

Chisholm Creek.—The Cariboo-Chisholm Creek Mining Company did a large amount of work on its property on Chisholm creek under the management of J. A. Macpherson. This company has spent a large sum in prospecting the ground with a Keystone drill, and this year did a certain amount of hydraulic work and also ran a long tunnel. This property had a certain amount of work done on it in the old days, when it was known as the *Snowden* ground.

In the Fort George Division there has apparently been considerable activity in quartz-mining, from the number of certificates of work applied for and issued.

There has also been a slight stir in quartz in the immediate vicinity of Barkerville—namely, on the Grouse Creek side of Proserpine mountain. Two inspections of the properties have been made, but it would appear that not enough work has been done as yet to in any way open up the properties.

The output of placer gold is estimated to be somewhat smaller than last year, and it is not thought that it will be much over $150,000, made up as follows:—

The J. Hopp mines, Lowhee, Stouts gulch, and Mosquito creek	$ 90,000 00
The *Point* mine	24,000 00
Houser Bros.	5,000 00
R. Rees	6,000 00
Cariboo-Chisholm Creek Co.	6,000 00
Various around Van Winkle	7,000 00
Reported from Fort George	1,000 00
Reported from 150-Mile House	17,000
Total	$156,000 00

A few more thousands may be added with safety to take in the amount recovered by individual Chinese miners.

Quesnel Mining Division.

In the Quesnel Division the larger hydraulic companies, whose product formerly swelled the output of the Division, have not been worked this past year.

The old Hobson property at Bullion, which has been the subject of disputed ownership for several years, is still tied up in litigation.

The usual amount of work was carried out on Keithley creek; the work is chiefly individual mining and the gross amount of gold recovered is small.

Prospecting has been actively carried on on the upper Horsefly river, but it is believed only a small amount of gold was recovered.

The Quesnel Hydraulic Company, about 12 miles below the Forks, did considerable work on its property, and reports having met with success in locating the old high channel, and that active productive mining will be continued next season.

Omineca Mining Division.

During the year 1916 lode-mining was active in that part of the Omineca Mining Division which is served by the Grand Trunk Pacific Railway. Roughly, this lode-mining territory lies along or near the Skeena and Bulkley rivers and their tributaries, and the most important camps centre around the towns of Hazelton and Telkwa. The production of the Division for the year is estimated to have been about: 11,375 tons, 798 oz. gold, 106,397 oz. silver, 1,262,730 lb. copper, 254,983 lb. lead, 168,616 lb. zinc, and $12,000 in placer gold.

GLEN MOUNTAIN.

The *Silver Standard* mine was operated steadily throughout the year and nearly 900 tons of ore was shipped. About 651 tons of silver-lead ore was shipped to the Trail smelter, containing 120 oz. gold, 74,593 oz. silver, and 162,051 lb. lead; and 209 tons of zinc-silver ore was shipped to the United States, containing 168,616 lb. zinc and 12,647 oz. silver. Development-work was carried on as well, consisting mainly of a crosscut tunnel which has been driven 880 feet to connect with the lower workings in the shaft on the main vein. This tunnel crosscuts four or five veins which are roughly parallel.

All these veins are more or less mineralized, and, in time, will all be prospected by drifts run on them. The main vein carries a considerable tonnage of ore which cannot be shipped direct and which will not pay to hand-sort, but which would be amenable to concentration of some kind. It is expected that when a number of the veins are more fully developed a sufficient tonnage of concentrating-ore will be demonstrated to warrant the erection of a mill. W. G. Norrie is in charge of the mine and is to be congratulated on the excellent showing which he has made with the property.

No other properties were worked in a large way on Glen mountain, and but little other than assessment-work was done on Nine-mile mountain; the *American Boy* was not operated during the year.

ROCHER DÉBOULÉ MOUNTAIN.

During the past year Rocher Déboulé mountain was the scene of considerable activity; much of the development carried out was due to the interest aroused by the success of the *Rocher Déboulé* mine during the last two years. Only the last-mentioned property shipped in 1916, but it seems quite likely that the future will see other properties added to the shipping-list.

A low-level tunnel was also started which will tap the main vein at a depth of about 1,100 feet and will be nearly half a mile long. This tunnel will also cut two other veins, which have good surface showings, before reaching the main vein.

The ore shipped during the year amounted to about 10,400 tons, containing 1,237,000 lb. copper as well as some gold and silver.

The following properties on Rocher Déboulé mountain were under development during the year: The *Hazelton View* group, owned by the New Hazelton Gold-Cobalt Mines, Limited; the *Cap* group, owned by Dennis Comeau *et al.*; the *Red Rose* group; the *Daley West* group, owned by the Rocher Déboulé Copper and Mining Company; the *Great Ohio* group; and several others on which assessments, etc., were done.

The *Hazelton View* group would appear to have a fairly good surface showing, the values consisting of gold contained in arsenopyrite. The property is, while virtually undeveloped, a promising prospect, and well worth spending money on.

An amalgamation of the *Delta* group and several other claims has been made by Harrison Clement, and it is understood that work on a large scale will soon be commenced.

The *Highland Boy* was tied up in litigation most of the year, but it is believed this is now settled and that work may be started before long.

TELKWA DISTRICT.

Very little ore was shipped from the Telkwa district, but considerable prospecting and development was carried on. Active work was continued on Cronin's mine, in the Babine range, and a sleigh-road to the mine nearly finished. The *Debenture* group, in the Babine range, was bonded by Mr. Ray and twelve men put to work; no further information is available about the property.

Dockrill & Jefferson developed a property in Howson basin which has a vein of high-grade copper ore, mainly chalcocite and bornite. A sleigh-road has been built from Telkwa and it is expected that over 300 tons of ore will be hauled out during the winter.

The property on Grouse mountain owned by Sam Bush and partners was taken up a year or so ago by R. Trimble, of Portland, and associates. Work was carried on this summer, a 2-drill gasolene-driven compressor being installed and a crosscut tunnel started.

Some activity was recorded in Hunter basin and up the Telkwa river, and it is reported that in this latter district one property has been bonded by the Tonopah Belmont Company of Nevada.

The camp in the Babine range due east of Telkwa, known as Dome Mountain camp, would seem to be a promising one. A number of claims have been taken up there, but comparatively little work has been done as yet. There are in the camp a number of well-defined quartz veins of a width of from 1 to 5 feet which are mineralized with pyrite and a little galena, and which carry very fair gold values—from $4 to $50 a ton. The showings warrant the thorough investigation of any one desirous of securing gold properties.

SKEENA RIVER DISTRICT.

The most important work in this district was on the *Fiddler group*, on Fiddler creek, which was bonded in July to an Edmonton syndicate; this syndicate immediately commenced work with a force of fifty to sixty men, and the plans include a four-mile wagon-road to the railway, a small hydro-electric plant, compressor, and development of the mine by drift-tunnels. If development proves satisfactory the mine will be equipped with a mill. The ore is a complex one consisting of iron, lead, copper, and zinc sulphides in a quartz gangue, with the principal values in gold, together with lesser amounts of silver, lead, and copper.

A good deal of prospecting was done during the summer on Legate creek, where one property was bonded by J. J. Price. Fifty tons was shipped from this property; the ore is a rather peculiar one, being an intimate mixture of galena and bornite carrying some values in silver. Some work was also done on St. Croix creek and Skeena mountain, near Skeena Crossing.

Nothing further was done with the iron and coal deposits on the headwaters of the Zymoetz river.

HUDSON BAY MOUNTAIN.

Some work was done on the properties on Hudson Bay mountain, particularly on the *Martin* group and some adjoining claims.

The Wright Coal Company commenced work on the coal-showings at Seton Station, on the Grand Trunk Pacific Railway, but with what success is not known. A donkey-engine was installed and the sinking of a slope to open up the seams was commenced.

PRELIMINARY REPORT ON HAZELTON DISTRICT.

BY THE ASSISTANT MINERALOGIST.

HAZELTON-TELKWA DISTRICT.

The writer spent the month of July in the lode-mining section of the Omineca Mining Division, and during that time examined a number of the more important properties, as well as getting general geological information about the district. In 1914 he examined the same district, spending over two months on the work, and his report is contained in Bulletin No. 4, 1915, of this Department. The work in 1916 was to supplement and bring up to date the information obtained in 1914.

The country covered in 1916 was, roughly, from Skeena Crossing to Telkwa, on the Grand Trunk Pacific Railway, although three properties west of Skeena Crossing were also examined. The detailed report on this work is now in course of preparation.

It may be well to here point out that this district continues to show a steady increase in mining development, and that it is one of the most promising fields in the Province for mining men of all kinds, from the prospector to the operator with large capital. It cannot be too strongly emphasized that, while the territory adjacent to the principal streams and their tributaries has been partially prospected, there still remain large areas which are unexplored.

The Rocher Déboulé mountains and many of the creeks tributary to the Skeena below Hazelton all offer promising country for prospecting. The Telkwa River district is also a section which should attract more attention. The whole Babine range seems an areas of probable mineralization, and one camp—that of Dome mountain—visited during the summer gives indications of being a productive gold camp in the future.

The mineralization is quite varied, consisting of gold, gold-copper, copper, silver, silver-lead, and silver-lead-zinc ores. There are two rock formations in which the ore-bodies are usually found. The older one is known as the Hazelton series and consists of quartzites, argillites, and sedimentary beds, together with interbedded lava rocks of all kinds, ash-beds, and tuffaceous rocks. The other formation is a series of small batholiths, stocks, and dykes of a granitic rock—often a true granodiorite—which have been intruded into the rocks of the Hazelton series. Mineralization has followed this intrusion and ore-bodies are found in both formations, as a rule somewhere in the vicinity of a contact between the two types of rock. It would be well for the prospector to bear this in mind, and, having familiarized himself with the two formations, to keep a close watch for mineral wherever he finds a contact between these rocks. These two formations are well shown in many places on Rocher Déboulé mountain and can be studied there.

SOUTHERN TRIP FROM HOUSTON TO ALEXIS CREEK.

After looking over the existing mines and claims in the Hazelton-Telkwa district, the main part of the season's work commenced, which consisted of a trip from Houston, on the Grand Trunk Pacific Railway, southwards to the Chilcotin country. The object of the trip was partly to explore the contact of the Coast Range rock with the older rocks on the east following southwards from the line of the Northern Transcontinental, and also to get information about some hæmatite iron-ore showings in the north-western end of the Chilcotin country.

It has been pointed out several times in the reports of this Department that mineralization and economically valuable ore-bodies have been found on both sides of the Coast range in many places, where the contact of the batholithic Coast Range rocks with the older rocks has been examined. In many places from Alaska to the International Boundary-line the contact-zones of the Coast range with the older rocks has been found to contain valuable ore-bodies, and according to the modern theories of ore-deposition such a contact area or zone should be a favourable place for minerals to be found; therefore it would seem advisable to explore the whole of such contact. It must be remembered that such a contact is not a line, but a wide area.

The mining camps situated on this eastern contact which show the continuity of the mineralization over considerable distances are in Alaska, in Stewart, Alice arm and Anyox, Hazelton, and away south in Lillooet. Between Hazelton and Lillooet there is along this contact-zone a blank of several hundred miles in which up to the present time practically no mineral discoveries have been made, principally due to the fact that it is virtually unexplored. It was, of course, impossible to follow exactly any such contact owing to lack of trails and the nature of the country. All that could be done was to come southward on the existing trails or Indian tracks, examining the country as well as possible.

In the first week in August a pack-train of ten horses and outfit was assembled at Houston for the long trip southward. The party consisted of an assistant—D. A. MacKinnon—a packer, a cook, and the writer.

On leaving Houston, the party proceeded to Owen lake, where some silver-lead-zinc claims have been staked; then on to Sibola mountain, where gold-quartz showings attracted a little attention two years ago. Sweeney mountain is near Sibola mountain, and on this some promising silver-lead showings have been staked. This section is practically in the contact-zone of the Coast range. A large lake near Sweeney mountain is called on the maps Emerald lake; this name should be Tahtsa lake, as the Tahtsa river flows out of it. A long spur runs out of the Coast range at this point, following for some distance down the Tahtsa river. A large area here seems to be a most likely one for discovering mineral, and the fact that some good showings have been found encourage the idea.

From Sweeney mountain an old trail known as the Bonthrone trail was followed south to the western end of Ootsa lake. This trail was blazed out in 1904, but is now nearly obliterated. In the spring of this year Sweeney and Benson went in to their claims on Sweeney mountain this way and partially cut out the trail. The writer's party cleared out the trail still more and cut out new trail in places, so that it should be possible for anybody to follow it now. The northern shore of Ootsa lake was followed easterly to where is situated Ootsa Lake settlement, which is beside the lake and about equal distances from the east and west ends. A large area of partially open country occurs here which is very suitable for stock-raising. Peavine, red-top, and meadow grasses are very luxuriant and abundant and are very suitable for stock-feed. The country is gradually being taken up by settlers.

The Forestry Service boat at Ootsa Lake, which is equipped with an Evinrude motor, was kindly loaned to the writer to make a trip on the big interior lakes. Ootsa lake was traversed to its head; thence up the Tahtsa river to where the White Sail river joins it, and then up this river to White Sail lake and on to the head of the lake. A portage of one mile and a half separates White Sail lake from Eutsuk lake—a magnificent body of water. This portage was made and all the upper end of Eutsuk lake was examined. The return was made by the same route, the total distance travelled being some 250 miles.

Arriving back at Ootsa Lake, the pack-train was again brought into use, and with a fresh outfit of supplies the Bella Coola trail was taken. This is an old and well-established Indian route, and before the advent of the Grand Trunk Pacific Railway many supplies for the northern country were packed in by this route from Bella Coola.

The trail swings around the eastern end of Ootsa lake, crossing three big rivers in quick succession, and then goes nearly south to Bella Coola. The country thus traversed is monotonous and of but slight apparent value. For the most part the rock formation consists of recent Tertiary lava-flows in which no evidences of valuable minerals have been found. The Bella Coola valley is a long deep gorge cutting transversely through the Coast range and affording an excellent section of it. Some magnetic-iron ore and copper deposits have been discovered in the Bella Coola region, but little is known of them as yet.

From Bella Coola the party went up the valley and out to Klinaklini, following the telegraph-line. On the headwaters of the Klinaklini river a deposit of hæmatite was examined. This deposit is as yet quite undeveloped, and also is at present a long way from transportation.

From Klinaklini the trail was taken to Tatla lake and then on to Tatlayoko lake. A gold property was examined at the southern end of the lake, on which work was done a few years ago.

From this point the trail was taken to Alexis Creek, and here the party was disbanded. A property owned by Mr. Newton some thirty-five miles from Alexis

Creek was the last thing to be examined. The writer and his assistant returned to the Coast via auto to Ashcroft and Canadian Pacific Railway, and the horses were taken back to the northern country by the other members of the party via the Blackwater-Fort Fraser wagon-road route.

In all, about 700 miles were covered with the horses and pack outfit, in addition to 250 miles of lake work. Where possible rough sketch-maps were made of the country, and it is hoped that with the aid of these, some improvements can be made in the existing maps of the region. Numerous rock samples were taken, and it is hoped that sufficient information was obtained to give a general idea of the character of the country traversed. It will, of course, be remembered this work was of the nature of an extremely rough and rapid reconnaissance, the party having been travelling nearly continuously, and so the notes on the geological features will necessarily be fragmentary and disconnected. The principal object of the trip was to view the country from the economic standpoint and find out possible and probable areas where mineral deposits of importance might be found.

CASSIAR DISTRICT.

The extensive area known as Cassiar District includes the following Mining Divisions: Atlin, Liard, Stikine, Skeena, Queen Charlotte, and Portland Canal.

Atlin Mining Division.

The Atlin District during 1916 maintained the rank which it has enjoyed for some years past as the chief producer of placer gold in the Province, and is estimated to have produced $320,000 worth of gold, which represents about 56 per cent. of the Provincial output of placer gold.

The following is an informal preliminary report by the Gold Commissioner regarding the conditions prevailing during the season of 1916:—

The output for this year will not quite come up to that of last year, and although there has been about $280,000 so far reported, I do not expect the aggregate to much exceed $300,000.

For this decrease in output various causes may be advanced, but the principal one was shortage of water and another was scarcity of labour. Although we had a heavier snowfall last winter than for some years previous, the ground was so thirsty in spring and early summer that the water from the melting snow disappeared without causing any flood or even abnormally "high water" in the creeks, and all who were interested in it were astonished and dismayed at its early and rapid disappearance with so little result from or evidence of its vanishment.

The scarcity of labour was contributed to by at least two unusual factors, one being the number of men who left the district either singly or independently or in contingents with a recruiting officer to enlist for active service abroad, and the other was the fact, I believe, that some men who were considered undesirable were turned back at the International Boundary, and they conveyed the impression as far and as fast as possible that labourers were not wanted. As a consequence, some operators closed down about midsummer for lack of labourers and water. There was an increase of output on Boulder and Otter creeks, but on all the others there was more or less of a falling-off.

Another deterrent factor was the enormously increased cost of powder and high explosives, which hitherto have been freely used by the operators, but they curtailed wherever possible this season.

On McKee creek the Delta Gold Mining Company operated for about the same length of time and with about the same number of men as last year, and the yield per square foot of bed-rock uncovered was about the same average, but for several recognized reasons the output was not quite so good. A lot of dead-work was done, however, preparatory for next season's work.

On Pine creek the Columbian Mines Company, representing the North Columbia Gold Mining Company and Pine Creek Power Company, Limited, under the management of Paul W. Greyer, commenced operations later and quit earlier than last year, putting in over two weeks less time and moving considerably less gravel, and yet they cleaned up within a very small amount of as much output this year as last—better "pay."

I have had no returns from Birch creek, but I regret to say the operators did not do as well as formerly; they did not have sufficient water to move the over burden to get at the "pay."

A sad catastrophe occurred on this creek about the end of the season. One of the old-timers in the camp (Frank Charlebois) was caught by an overhanging bank and smothered.

On Boulder creek there was a continual struggle for water, and one operator, J. H. Black, succeeded in increasing the utility of what there was by building three small reservoirs, and incidentally increased the output by $2,000 over that of last year. He hopes to put in more efficient reservoirs for next season and to profit by so doing.

On Ruby creek Mr. Daulton, for the Placer Gold Mines Company, operated for nearly the same length of time as in 1915 and with nearly as large a force, but owing principally to shortage of water he was unable to move as much gravel, and consequently had a considerably diminished output. He expects better water and results next season.

On Otter creek Mr. Maluin's outfit actually got down to "pay" late in the season, and increased the output more than $8,000 over that of last year.

On Spruce creek McCloskey did not operate at all, apart from some prospecting-work that was being done by about a half dozen men; and while some of the operators on this creek have done very well, the aggregate output to date is nearly $30,000 less than for last year, but there are some parties to hear from who will reduce that deficit considerably.

The indications are that there will be increased activity in development on this creek next year, particularly on the upper and undeveloped portions.

O'Donnel river was disappointing this season and the aggregate output less than that of last year. The O'Donnel Placers Company, under the direct superintendence of J. Frank Breeze and the general management of Paul W. Greyer, employed twelve men there throughout the season and moved a large quantity of gravel by hydraulic methods, but a large portion of the ground thus worked had been previously "drifted" out, and the greater part of the values having been thus recovered left poor "pay" for the hydraulic operator, but they claim to have gotten through the worked-out portion and to expect good returns for next season.

Nothing worth mentioning was done by an[illegible]se on this stream this season.

Very little was done on Wilson creek, an[illegible]ically nothing on Burdette or Davenport creeks.

One or more men on each were prospecting on Graham, Volcanic, Cracker, Horse, Hemlock, Lincoln, Bull, Fox, and Rob Roy creeks, and while I have no definite reports of results from any of them, I find that all of the men so engaged have been encouraged to continue their researches.

A number of leases have recently been located on Rob Roy creek, which is tributary to Sucker river, near Teslin lake. This stream is shown on some of the maps as "Rapid Roy."

Men are working this winter on Pine, Spruce, Boulder, Ruby, Otter, and O'Donnel, and the output of gold from some of those operations is very good.

QUARTZ.

I have not had any formal report from the *Engineer* mine, although a considerable f[illegible] men was engaged there during the season, and the mine has been exan[illegible] relays of mining engineers and experts representing would-be pur chasers, but up to my latest information the ownership of the property had not changed, although prices had been offered which would have tempted many.

Some development-work was carried on in the Rainy Hollow section, and there, also, relays of mining engineers and experts were in and out of the district at intervals during the summer, and my latest information was to the effect that some of the owners and the representatives of purchasers were in Seattle trying to come to agreement as to terms, etc.

More attention than usual was paid to this (Atlin) part of the district this season by those "scouts," but no transfers or assignments have been reported.

The Laverdiere Bros. are back in the district and have reported some high-grade discoveries on Torres inlet, near their other properties, and they are developing there this winter.

The other quartz properties throughout the district are being kept alive, and altogether more attention has been paid to this industry this past season than for several seasons past.

Nothing has been done with respect to our coal-deposits during the year.

Stikine and Liard Mining Divisions.

The Stikine and Liard Mining Divisions are only accessible through a strip of Alaskan territory and by following up the Stikine river, on which rather precarious service is given during a portion of the summer by shallow-draught gasolene-driven boats.

For this reason alone it is impracticable to do any other form of mining than placer-gold mining; although lode minerals have been found in several places, they have not as yet been worked.

In the Stikine Division there has been no organized placer-mining; the only work of this description consisted of a little sniping on the bars of the Tahltan river.

The Liard Division is on the Arctic watershed, the waters flowing into the McKenzie river. The principal placering operations in this Division carried on of late have been by the Dease Creek Syndicate, formerly the Boulder Creek Mining Company, which has been operating an hydraulic plant on Thibert creek, which flows into Dease lake at its outlet or northern end.

This property was fully described in the Report of 1912 and has since then been a steady producer, recovering between $16,000 and $20,000 each year.

Ryan's property on Dease creek has been acquired by a partnership from outside—Hannaman & Roof—and will be operated on a larger scale in future, and is reported to have done well this year.

Active prospecting has been carried on down the river at McDame creek and below in a district neglected of late years.

The output of the district is estimated at $30,000.

Portland Canal Mining Division.

No direct report has yet been received from this Division, but it is known that no great amount of productive mining was done.

As far as at present known, some small shipments have been made to Tacoma from the *Grey Copper* and by F. W. Falconer.

Prospecting has been fairly active and small deposits of quite high-grade ore have been uncovered.

Queen Charlotte Mining Division.

Very little information has been received as yet regarding mining on Queen Charlotte islands during the past year, but it is not believed that very much was done, other than prospecting development.

The *Ikeda* mines were worked on a larger scale than for some years previously; a production of about 1,000 tons of 7-per-cent. copper ore was made and shipped to the Anyox smelter.

The *Early Bird*, on Gold harbour, Moresby island, milled some gold ore, but details are yet lacking.

Boring for coal and oil was proceeded with to some extent, but not as vigorously as in former years.

Skeena Mining Division.

The operations of the Granby Consolidated Mining, Smelting, and Power Company at Anyox again were the most important in this Division. This company has continued all year in its usual progressive manner and the output was larger than ever. The tonnage of ore mined and smelted was about 744,000 tons, carrying about 25,923,000 lb. copper, 164,673 oz. silver, and 4,266 oz. gold. In addition to this, the Anyox smelter treated ore from the company's mines in Alaska and an occasional shipment of custom ore.

The annual report of this company for the fiscal year ended June 30th, 1916, shows the company to be in a very sound condition in every way, and that the year was the most profitable in the history of the company. One statement in the report which shows the progressive nature of the company is that "a research department has been inaugurated and much useful information secured during the year." Part of the work of this department has been to make an exhaustive investigation into the oil-flotation method of concentration with a view to utilizing it on some of the low-grade ore at Anyox; other problems have also been given attention, including the handling of flue-dust.

Owing to the nature of the ore, both lime and silica flux have to be brought in for smelting, and as far as possible this flux is secured in the shape of low-grade ore. Development and diamond-drilling during the year have increased the ore reserves slightly, the new ore proved up more than balancing that mined. Many improvements have been made at the mine, including an auxiliary steam plant for use in the winter months when the water-power fails, new, crushing plant, increase of haulage capacity with heavier motors, etc., new electric hoists, and more buildings for employees.

Costs of mining went up, due principally to higher wages to the men and higher prices of supplies. Cost of ore mined, crushed, and delivered on cars was 99.6 cents a ton, as against 86.1 cents in the previous year. Cost of smelting and converting was slightly less than the previous year, being $1.804 a ton as compared with $1.877.

ALICE ARM.

Another section of the Skeena Mining Division which has attracted considerable attention during the past year is the head of Alice arm. The property which has been most developed is the *Dolly Varden*, which is now said to be almost a proven mine. No ore has been shipped, but a road twenty miles long has been completed into the property, and production should be commenced in 1917. The main values are in silver.

Many other claims on Alice arm are being worked, and generally the district is regarded as a most promising one. It seems likely that a lot of the properties in this section will require concentrating plants before any large outputs can be made.

During the summer the Bureau of Mines secured the services of J. M. Turnbull, M.E., for two months to make an examination of the Alice Arm district. Most of the important properties were visited by him and data obtained for a general geological report on the district. This report has not yet been received.

PRINCESS ROYAL ISLAND.

The opening-up and equipping of the property of the Surf Inlet Mines, Limited, on Princess Royal island, recently acquired by the Belmont Canadian Mines, Limited, a subsidiary of the Tonopah Belmont Company, was actively carried on during the year. Developments on the lower levels of the mine are said to have been very satisfactory, both in regard to the quantity of ore disclosed and the values of this ore. The ore, which is a white quartz, containing pyritiferous iron sulphides carrying gold, together with a little copper and silver, is a difficult ore to mill so as to save the most of the values. Extensive tests have been carried out in order to determine the right kind of mill to install. At first it was intended to roast the ore, securing sulphur dioxide from the pyrite, which would be used to make sulphuric acid; this acid would then be used to leach the copper from the ore; and finally the balance would be cyanided to obtain the gold and silver values. It is understood now that, as very favourable smelting terms have been offered by the Granby Company (which is desirous of obtaining this type of ore), the ore will be concentrated probably by combined water and oil treatment and the concentrates shipped to Anyox.

EAST KOOTENAY DISTRICT.

This district includes Fort Steele, Windermere, and Golden Mining Divisions. In recent years there has been but little mineral production in Windermere and Golden Divisions; it was expected that immediately after completion of the Kootenay Central Railway, from the [illegible]adian Pacific main line southward through the valleys of Columbia and Kootena[illegible]ers to the Crowsnest Railway east of Cranbrook, there would be mining activit[illegible] Windermere Division, but this expectation had not yet been realized to any c[illegible]rable extent until this past season, when R. R. Bruce reopened the *Paradise* [illegible] and shipped some 300 tons of lead-silver ore to Trail.

Work has been g[illegible]on at the *Monarch* mine, near Field, the particulars of which have not been r[illegible]ived as yet, but it is expected the output will be about the same as in 1915, when some 5,500 tons of ore was mined, carrying lead and zinc with small silver values.

Some work was also done in the Spillimacheen country, but no details have been received yet.

In Fort Steele Division the position is satisfactory as regards metalliferous mining, since the production of silver and lead was larger in 1916 than in any other year since 1909.

The most important property in this Division is the *Sullivan*, owned by the Consolidated Mining and Smelting Company, which in 1915 shipped some 44,000 tons of ore, while in 1916 the output is expected to be about 100,000 tons, estimated to contain 501,590 oz. silver, 26,466,000 lb. lead, and about 12,000,000 lb. zinc.

This ore, being an intimate mixture of lead, zinc, and iron sulphides, has always been found most difficult to treat; this difficulty has been somewhat overcome by the new electro-chemical zinc process recently installed at Trail, and it is hoped will be completely solved by a preliminary concentration at Moyie, where the old *St. Eugene* concentrator has been remodelled and adapted for this purpose.

Ore was shipped from the *Park* group, near Kimberley, and it is believed the property is being steadily developed.

COAL-MINING.

Two coal companies operated in the Crowsnest coalfield in 1916—namely, the Crow's Nest Pass Coal Company and the Corbin Coal and Coke Company. The first-mentioned company worked eight mines at its Coal Creek Colliery and four at its Michel Colliery. Its gross output of coal was estimated at 812,013 tons, as compared with 790,028 tons in 1915; there was, consequently, an increase last year over 1915 of 21,985 tons. About 346,676 tons was made into coke, leaving a net production of rather more than 465,337 tons of coal, against 446,537 tons in 1915.

The output of this company would have been considerably greater but for an explosion in one of its most productive mines at Michel, which so wrecked the mine that it is still under repair and making no appreciable output, while later in the year a series of "bumps" in its No. 1 East mine at Coal Creek reduced the output of that mine to about one-third its normal output. A shortage of labour also hampered the company's operations very considerably.

The Corbin Coal and Coke Company is estimated to have produced some 68,806 tons of coal, an increase of 6,352 tons over the preceding year.

COKE-MAKING.

Since the closing of the Hosmer Company's ovens in 1914 the only coke-making operations carried on in this district are those at the Crow's Nest Pass Coal Company's ovens at Fernie and Michel respectively. Coke made by this company finds its chief market at the smelters in Boundary District and at Trail, in West Kootenay, both in British Columbia. A much smaller demand from the United States is supplied after requirements of smelting-works in the Province have been met.

It is worthy of mention that of a total of approximately 3,350,000 tons of coke made in British Columbia in all years to the end of 1915, about 2,902,000 tons was made at the Crow's Nest Pass Coal Company's ovens.

In 1916 the Crow's Nest Pass Coal Company is estimated to have produced 242,431 tons (2,240 lb.) of coke as against 240,421. This increase is slight and does not represent what the increase would have been had labour been available for the coke-ovens, as there has been a serious coke shortage, hampering the smelters of the Interior.

WEST KOOTENAY DISTRICT.

The West Kootenay District embraces a number of very important and productive mining camps situated in several different Mining Divisions. The most important of these is the Rossland camp, situated in Trail Creek Division; and other important mining districts are at Silverton and Sandon, in the Slocan Division, at Riondel, Ainsworth, and other places in the Ainsworth Division, and in several places in the Nelson Division. Revelstoke, Trout Lake, and Lardeau Divisions are also included in this district, but in the last few years but little ore has been mined in them.

The total value of the metalliferous production of the West Kootenay District for the year 1916 is expected to have been about $9,000,000, as compared with $7,248,483 in 1915, which is partly accounted for by the higher prices of the metals mined.

Ainsworth Mining Division.

Preliminary figures for Ainsworth Division, while not complete nor exact, show that nearly 60,000 tons of ore was mined and shipped in 1916, as compared with 42,650 tons in the preceding year. It is estimated that this ore contained over 8,000,000 lb. lead, as compared with 3,500,000 in 1915. This large increase in the lead is due to a much greater production from the *Bluebell* than in 1915, and a large output of heavy lead ore from the *Highland*, which shipped very little in 1915.

The following list shows the tonnages shipped by the more important mines in the Division:—

	Tons.
Bluebell	47,000
Florence	3,200
Highland	3,000
No. 1	2,780
Utica	980
Comfort	500

In all, about twenty mines shipped, and the total tonnage from the Division was about 58,000 tons, carrying 55 oz. gold, 300,000 oz. silver, 8,000,000 lb. lead, and 150,000 lb. zinc.

One of the important developments in Ainsworth during the year was the building of a 300-ton concentrator by the Florence Company to treat the ore from the company's mine. The *Highland* mine of the Consolidated Company, after a year of inaction in 1915, shipped steadily in 1916 and contributed materially to the lead-output of the Division. The other mines of the Consolidated Company, the *No. 1* and *Banker-Maestro*, were worked throughout the year and made average outputs. The *Utica* was steadily worked and had a very satisfactory year.

The old sampling-works at Kaslo had its magnetic separation plant overhauled and concentrating machinery was installed, the outcome being the successful treatment of ore and concentrates received in the latter part of the year.

Slocan Mining Division.

Under this heading is included Slocan City Mining Division; the output from the latter is relatively small.

During the year 1916 mining in the Slocan Division was in a decidedly satisfactory condition, although the tonnage of silver-lead ore produced was a little less than in 1915; on the other hand, a larger tonnage of zinc ore and concentrates was shipped.

The following table gives the production of this Division for 1915 and the estimate for 1916:—

Year.	Ore.	Gold.	Silver.	Lead.	Zinc.
	Tons.	Oz.	Oz.	Lb.	Lb.
1915	114,292	26	1,812,550	14,925,345	8,684,572
1916	122,912	30	1,608,800	14,434,585	18,059,887

The reduction of lead-ore output, which automatically lowers the silver production, is mainly attributable to a lessened production from the *Surprise* mine, due to the destruction by fire of the concentrating-mill that had previously treated the ore; the mine could not ship during a large part of the year, but a new mill has been built and is now in operation. Other contributing factors to a lessened lead production were the delay in making changes at the *Slocan Star* mill and to the fact that market conditions made it good policy to produce as much zinc ore as possible, thus curtailing the lead-output.

The *Standard*, at Silverton, was again the largest shipper of both silver-lead and zinc ore. About 42,000 tons of ore was mined and milled, containing approximately 400,000 oz. silver, 6,500,000 lb. lead, and 9,500,000 lb. zinc. Further progress was made at the mill in adapting the oil-flotation method to a further recovery of values in the tailing from the water-concentrator.

The *Galena Farm* was the next largest shipper of lead ore, and also made an important output of zinc concentrates; the tonnage of ore mined and milled being a little over 22,000 tons, while the zinc-output was nearly 2,500,000 lb.

The *Lucky Jim* had a very satisfactory year, and the mine is steadily paying off its debts and will probably soon have its financial position cleared up. A considerable tonnage of zinc ore and concentrates was shipped to smelters in the United States, but towards the end of the year arrangements were made to sell the concentrates to the Trail smelter, where they are treated in the electrolytic zinc plant.

The *Slocan Star* worked steadily throughout the year, made changes and additions to the mill, and shipped a large accumulation of zinc-silver concentrates, for which a market had not previously been obtainable. This accounts for a large increase in the zinc production of this company as compared with previous years.

The *Rambler-Cariboo*, while operating steadily throughout the year, is estimated to have milled a little less ore than in 1915, with corresponding decreases in silver, lead, and zinc.

As before indicated the *Surprise* was handicapped by lack of milling facilities, and therefore the output was less than one-tenth of that in 1915. This condition has been altered by the completion of a new 100-ton concentrator, and the *Surprise* in future is expected to become one of the most important of the Slocan shippers.

Over thirty mines shipped from the Slocan Division during the year 1916, and only twelve of these produced less than 100 tons. Ten more produced between 100 and 1,000 tons, and the balance each shipped over 1,000 tons in the year. Deep development in the mines of this district is apparently proving satisfactory and has resulted in greater confidence being felt as to the future of mining in the district. In this connection it is interesting to note that the *Payne*, in past years the most famous of all the Slocan mines, has again entered the shipping-list, being credited with a production of 55 tons.

In Slocan City Mining Division the *Ottawa* group, owned by the Consolidated Company, has had a force of men at work all year on development-work, the ore taken out in the course of the work being shipped; prospects for the ensuing year are bright.

The *Black Prince* mine, under lease to J. T. Tipping, was worked all summer and 127 tons of high-grade silver-lead ore was shipped.

The *Enterprise*, under lease to E. Shannon, was worked for seven months in the year and 104 tons of ore shipped.

Work was carried on at the *Alice S.*, *Inco*, *Meteor*, and *Anna* properties, and on others assessment-work was done.

Nelson Mining Division.

Preliminary figures for the Nelson Mining Division indicate that the output of ore for 1916 was about 22,500 tons, as compared with 23,634 tons in 1915. Gold and zinc production figures both show small decreases, while the lead produced was nearly 1,200,000 lb., against 967,775 in 1915, and silver shows an increase from 9,405 oz. to about 50,000 oz. This increase in silver was due to the operation of the *Molly Gibson* mine, owned by the Consolidated Company, which was not worked in the previous year, and to a silver-output from the *Eureka* mine.

The Sheep Creek camp again fell away this year, which is reflected in the lessened output of gold from the Division. The *Motherlode*, which was formerly a considerable producer, was closed down all year. The *Queen* is expected to have made its customary yearly production of about 5,000 oz. As far as has been learned, practically no other ore was mined or milled in the Sheep Creek camp. In Bayonne camp, over the summit of Sheep creek, 130 tons of silver-lead ore, carrying also a little gold, was packed out from the *Spokane* group.

Nothing definite has been heard yet regarding Ymir camp, although it is believed the *Yankee Girl* was developed throughout the year; nothing has been heard as to whether or not ore was shipped from this mine, but it is believed that the plans for building a concentrator are being continued.

The renewal of production from the *Molly Gibson* is a gratifying feature, and it is anticipated that shipments will be continued.

The *Eureka*, near Nelson, which was a shipper some years ago, but which had been idle for some time, was taken over by a new company two years ago, and during 1916 commenced regular ore shipments to the Trail smelter. Some 1,500 tons was shipped, the ore carrying values in copper and silver.

The *Granite-Poorman* group was worked all year, and it is expected that a considerable production of gold was made, better than in several recent years. For the past two years the property has been under the control of the Crilly-Wilson Syndicate, but it is now reported that United States men have secured it who are going ahead with deep-level development.

Late in the year development-work was resumed at the *Silver King* copper-mine, near Nelson—owned by the Consolidated Company and formerly the largest shipper in the Division—after two years of inactivity.

The *Emerald* lead-mine made a larger production than in 1915, the figures being 1,350 tons as compared with 1,100, and increasing ore reserves are being developed.

The *Molly* molybdenite-mine was bonded by the Orillia Molybdenite Company, but very little work was done. A shipment of 15 to 20 tons was sent to Orillia, Ontario, for treatment, which averaged about 12 per cent. molybdenite.

The French Complex Ore Reduction Company disposed of the bonds guaranteed by the Provincial Government, and thus secured money to go ahead with the installation of a small zinc plant at Nelson. When completed this refinery will be in the field for custom zinc ores, and more particularly for complex zinc-lead-silver ores, which are not amenable to ordinary fire-smelting.

This plant does not pretend to be anything more than a demonstration plant on a scale only large enough to show the economic possibilities of the process, and prove on a working scale the problems which had been solved in the laboratory. The plant is designed to produce about 2 tons of metallic refined zinc a day from zinc concentrates.

The plant has been erected in the old building originally erected for the Snyder electro-thermic zinc-smelting process in the eastern suburbs of Nelson, which process was not successful, and the buildings and plant came into the possession of the Government some years ago. The old building has been remodelled and enlarged, while much of the old plant has been utilized for this new process.

The old grinding plant, bins, and mechanical roaster have been renovated and are now ready for use. Several large leaching and solution tanks have been erected, and also a series of electro-precipitation tanks, now all ready for the electric connections. The electricity will be obtained from the hydro-electric plant of the city of Nelson near Bonnington falls.

In December the plant was nearing completion, and was expected to be started up early in the new year if the weather was not too cold.

Trail Creek Mining Division.

The important productive section of this Division is the Rossland camp, but the large smelting and refining plant of the Consolidated Mining and Smelting Company, which draws ore from many parts of southern British Columbia, is situated at Trail, also in the Trail Creek Division. Production from the Rossland camp is from three groups of mines—namely, the *Centre Star* and *Le Roi* groups, owned by the Consolidated Company, and the *Josie* group, owned by the Le Roi No. 2 Company.

It would seem as if the tonnage figures for 1916 show a decrease as compared with the previous year, as is set out in the following table:—

	1915, Tons.	Est. 1916, Tons.
Centre Star-War Eagle group	180,508	163,000
Le Roi group	131,319	130,000
Josie group	26,538	15,800
Phoenix	5	...
Velvet	78	124
Inland Mining Company	120	...
Totals	338,568	308,924

This decrease in output can at least be partially accounted for by, at different times during the year, a shortage of coke, which necessitated a curtailment of the smelting operations. On this account the mines of the Consolidated Company ceased production during the latter two months of the year, confining the operations to development-work. It is expected that the gold-copper ore of the Rossland camp would be about the same grade as in previous years. During the year development-work was kept up at the big mines as has been customary in past years, but no important changes or improvements were made.

TRAIL SMELTER.

During the past year the Consolidated Mining and Smelting Company made many additions, changes, and improvements in the smelting and refining plants situated at Trail. The actual production of refined zinc and refined copper was commenced, and this fact is the more noteworthy as this is the only place in Canada where such refining is being done. The company now buys and treats at Trail gold, silver, lead, copper, and zinc ores, and the refined products produced include: Gold bricks, silver bars, pig lead, sheet lead, lead pipe, refined zinc, electrolytic copper, copper sulphate, and arsenic and antimony compounds as by-products.

The erection of the electrolytic zinc-refinery was commenced in the fall of 1915, and by rushing the construction-work the plant was in operation early in 1916. It was designed primarily to treat the complex zinc-lead ore of the *Sullivan* mine, owned by the company, where very large reserves of this class of ore have been proved. The ore is roasted and then leached with a solution of weak sulphuric acid. This dissolves out the zinc, which is then precipitated in electrolytic tanks. The lead and low silver contents of the ore remain as an insoluble residue from the leaching process and are sent to the lead-furnaces for smelting. This process enables the zinc contents of the ore to be saved (at least, in large part) and also makes a much better product for the lead-stacks than the crude ore. The cost of producing zinc by this method is about the same or possibly a little higher than by fire-smelting, but this latter process could not be used with *Sullivan* ore.

In addition to the *Sullivan* ore, a small amount of high-grade zinc concentrates from the *Lucky Jim* mine has been treated at this plant. The capacity of the plant is from 25 to 30 tons a day of refined zinc, which means that 150 to 200 tons of ore is being treated daily.

The two copper-converters, the installation of which was completed during the year, enabled the matte from the copper-furnaces to be converted into blister-copper at Trail instead of shipping to Tacoma, as was formerly done. An electrolytic copper-refinery, with a daily capacity of 10 tons, was erected and commenced operation during the year. In addition to the company's own blister-copper, some blister-copper from the Greenwood smelter of the British Columbia Copper Company was refined; the refinery is now being enlarged to make a daily output of 15 tons of refined copper. In addition to the zinc and copper refineries, much other equipment of various kinds was added to the smelter, changes and improvements for handling the ore were made, and considerable additions to the Cottrell smoke- and fume-dust precipitating plants were installed.

The expenditure of several millions of dollars by this company in new plant shows the confidence felt by the management in the future of mining in southern British Columbia.

Other West Kootenay Divisions.

In the Arrow Lake Division some further work was done on the *Millie Mack*, situated near Burton, and some ore was shipped.

The *Lanark*, in Revelstoke Division, was operated during the year and shipped about 400 tons of silver-lead ore.

Renewed interest was apparent in the Lardeau and Trout Lake Divisions, and it is possible that in the future some of the low-grade complex ore-bodies of that region will be worked. Ore production was small, but in most instances concentration of the ore would be required before any large tonnage could be handled at a profit.

A report on these Divisions was made by Newton W. Emmens in 1914 for this Department, and was issued as Bulletin No. 2, 1915; copies of this report can be had by applying to the Provincial Mineralogist.

No information has as yet been received in regard to mining and prospecting in the Revelstoke Division, with the exception of the *Lanark* mine, previously noted.

BOUNDARY DISTRICT.

The name "Boundary District" includes the following Mining Divisions: Greenwood, Grand Forks, Osoyoos, Similkameen, Nicola, Vernon, Kamloops, Ashcroft, and Yale. Of these, the first three are the most important and each year from 40 to 50 per cent. of the total tonnage of ore mined in the Province comes from them. The largest individual shipper is the Granby Company, with mines at Phoenix and a smelter at Grand Forks.

Ashcroft Division has been the scene of considerable mining activity in the past year and promises well for the future. Similkameen Division also has at least one big mining proposition well under way, and should before long contribute a substantial yearly tonnage. All the other Divisions have some mining and development work going on in them, and it seems quite probable that the Boundary District will, in the future, at least maintain its position as the largest tonnage-producer in the Province.

The large tonnage of ore from this district is largely made up of low-grade copper ore, and during the past year this ore has been a little lower grade than ever before; the reason for this being that the high price of copper made it profitable to handle ore of such low grade which it would not pay to work at the normal price of copper. It is indeed noteworthy that some ore from the Granby Company was handled at a profit from which was made a recovery of only 10 lb. of copper a ton and about 60 cents a ton in gold and silver. Similarly, the British Columbia Copper Company handled much low-grade ore.

The approximate output of the district is estimated to have been 1,693,550 tons, which gave: Gold, 82,731 oz.; silver, 316,128 oz.; copper, 16,618,284 lb.; lead, 9,422 lb. As compared with 1915, these figures show an increase in tonnage and a slight decrease all round for the contained metals.

Grand Forks and Greenwood Mining Divisions.

Granby Consolidated Mining, Smelting, and Power Company.—Approximate figures of production in 1916 from this company's group of mines at Phoenix are: Ore shipped, 1,001,500 tons; metals produced: Gold, 29,182 oz.; silver, 176,172 oz.; copper, 13,961,340 lb. The output of ore was curtailed during the latter part of the year o[illegible] partial shut-down of the smelter which was unable to get sufficient coke t[illegible] full capacity, owing to labour troubles in the Crowsnest coalfield.

N[illegible], of importance were made at the mines or smelter, everything running as in former years. The electric shovel was operated throughout the year for loading the ore.

British Columbia Copper Company.—This company operated steadily during 1916, and at the Greenwood smelter one furnace was in blast all year, and the second one during part of the time. The company draws its ore mainly from the *Mother Lode* mine and a little from two properties in the State of Washington. Some custom ore is also bought by the smelter.

The production from the *Mother Lode* for the year is expected to be about 200,000 tons, containing 8,000 oz. gold, 80,000 oz. silver, and 2,500,000 lb. copper. These figures show an increase as compared with the year 1915.

Other Properties.—So far as is known, the *Jewel* gold-mine and cyanide plant in Long Lake camp did not make any appreciable output, the mine being closed during most of the year.

The *Emma* mine, in Summit camp, formerly controlled by the British Columbia Copper Company, but now owned by the Consolidated Company, was operated during the year and 14,000 tons of ore shipped to the Trail smelter. This ore carries a high percentage of iron and is valuable as a flux.

Very little was done in the small properties surrounding Greenwood, but some further work was done in the *Argo* tunnel.

GRANBY RIVER.

A few properties on Granby river, mostly in Franklin camp, were examined and some work done on them during the year. The most important mine again was the *Union*, which shipped some 261 tons to the Granby smelter.

The *Pathfinder* also shipped some ore, but the amount is not known as yet.

Several car-loads of ore were sent to the Greenwood smelter from the *Seattle* property, near Bannock City.

WESTKETTLE RIVER.

On Wallace mountain, near Beaverdell, several properties were worked under lease and bond, and ore shipments were made via the Kettle Valley Railway to the Trail smelter.

The *Bell* was leased to Robert Perry, who shipped two cars of ore which are said to have returned very high values.

The *Sally* was also worked under lease and some ore shipped.

The *Rob Roy*, which is one of the claims in the *Sally* group, was bonded during the year and work is now being done on it.

The *Carmi* mine and stamp-mill at Carmi remained idle during the year, but another property near the *Carmi* was worked under lease and bond.

Osoyoos Mining Division.

The *Nickel Plate* mine and stamp-mill, owned by the Hedley Gold Mining Company, was again the main producer in this Division. It is expected that the tonnage of ore mined and milled in 1916 was about the same as in the previous year, which means that about 70,000 tons of ore would be treated, yielding somewhere between $700,000 and $800,000 worth of gold.

The company has during the year changed the method of treating the ore so as to treat it entirely at Hedley. Up to the present time the mill practice has been to concentrate the ore, sending the sulphide concentrates to Tacoma to be smelted, and then cyanide the tailings. (Amalgamation was discarded some years ago.) By this system the bulk of the values were contained in the concentrates shipped to Tacoma. The new method is to cyanide the whole ore and eliminate entirely the making of concentrates. The main reason for this change is that the character of the ore is changing, the percentage of sulphides increasing, so that now the cost of transporting and smelting the large amount of concentrates is a very serious item in the per ton cost of treating the ore.

In the last annual report of the company E. E. Merrill, president, says:—

"The increased baseness of the ore with depth, which increases concentrate tonnage and lowers the grade of same, necessitates a change in our milling system. We have carefully tested out straight cyanidation of all our ore with fairly good results, and we plan to install the necessary machinery for this treatment during the early part of 1916, which we believe will be some improvement over present method of shipping concentrates to smelter.

"Conditions in the lower levels of the mine have, within the last two years, changed considerably. While the ore-bodies are larger than in the upper levels, and stronger in every way, and, contrary to the rule in most gold-mines, maintain at least the same grade per ton, the specific gravity of the ore has increased so that it requires only 10 cubic feet of ore to the ton, where formerly it required more than 12 feet to make a ton. This is caused by the increase in arsenopyrite and adds considerably to the cost per ton of ore milled, as the concentrate tonnage has increased from 3,831 tons in 1913 to 6,218 tons in 1915. This condition, together with war prices and miners' wage increase, all tend to reduce the profits. For this reason tests have been made to determine the most profitable method of treating this ore. For two months 25 per cent. has been treated by total cyanidation with very satisfactory results."

Some further prospecting and development have been done on claims in the vicinity of Hedley, but no information has been received of the results attained.

Claims in Fairview camp have also been worked, but it is believed that very little ore has been shipped.

Similkameen Mining Division.

The metalliferous production from this Division during the year 1916 was again very slight, but the developments at Copper mountain, near Princeton, make it reasonably certain that a considerable output will be made in the near future.

The Princeton Coal and Land Company very materially increased its output of coal and is now marketing about 300 tons a day.

The British Columbia Copper Company has at length commenced the actual work of opening up and equipping its Copper Mountain properties. The diamond-drilling and prospecting of previous years had definitely established the existence of a large tonnage of low-grade copper ore, so that all that remained was to get the property in shape for ore production. A low-level tunnel was driven and drifts put in to get underneath the ore-bodies; the method of mining will be by glory-holing and the "big stope" method.

Owing to the nature of the ore it will have to be concentrated before smelting, so the construction of a mill with a capacity of 100 tons a day is under way. This mill will serve as an experimental plant to decide the best system of concentration to use, and will also be one unit of the 1,000-ton mill which is planned for the mine. Power is now being obtained from the plant of the East Princeton Cement Works, in which coal from the Princeton Coal Company is burned, electric power being generated and transmitted to the mine, some twelve miles distant. Water is obtained from the Similkameen river by pumping. The eventual mill process will probably be water-concentration followed by oil-flotation treatment of the tailings from the water plant.

The Kettle Valley Railway is building a spur line from Princeton, and the concentrates will be hauled to the Greenwood smelter, owned by the British Columbia Copper Company, and there smelted.

Some work was done on the Voigt properties in Voigt camp, but as yet nothing has been done towards actual ore production.

Exploration-work on claims on Kennedy mountain was started by the British Columbia Copper Company during the year, and 709 feet of diamond-drilling and 823 feet of tunnelling was done.

TULAMEEN SUBDIVISION.

A car of copper ore was shipped from the *St. George* claim, on Bear creek, owned by Charles F. Law *et al.* Another car-load of ore was shipped from the *Totem Pole* claim, on Thynne mountain.

On Granite creek little or no placer-mining was done this year, the extreme high water having washed out the workings prepared for this mining season.

On the Tulameen river a small back-channel was worked during the past season by Mr. Schubert with three men; 2,000 yards of pay-dirt was washed, said to average 50 cents to the yard, and, besides, a lot of outside work was done which will enable the property to work to advantage next year.

The Efangay Syndicate, representing Spokane people, has acquired two leases on the Tulameen river, one below and one above Bear creek. On the lease below Bear creek a wing-dam has been constructed 750 feet long, besides head-dam; the river has been turned out and a gasolene-driven pump has been installed to keep the workings dry.

A number of individuals have worked the Tulameen river in a desultory way with rockers and sluice-boxes, and they are said to have done well. The very high market price of platinum is stimulating this individual work.

Nicola Mining Division.

For several years past previous to 1915 lode-mining in the Nicola Mining Division has been inactive. The mineral claims staked in 1898, 1899, and 1900, particularly on Ten-mile creek and the Mamete Lake district, were remote from transportation, even after the Kettle Valley Railway was built, because of the long wagon haul to the nearest station over poor roads. During 1915 the high price of copper encouraged the owners to endeavour to overcome this difficulty, with the result that the old locations, known as the *Copper King* group of mineral claims, near the foot of Mamete lake, were reopened and some shipments made to the Trail smelter. This led to investigations being made by the representatives of companies into the merits of other properties in the same locality, but nearer to the railway. Such investigations resulted in the bonding of the old *Aberdeen* mine, owned in Coutlee, and the improvement of a part of the old wagon-road, as well as building a new road a portion of the distance from the mine to the railway.

The old *Aberdeen* mine is a few miles down the creek from the *Copper King* and about twelve miles north from Coyle, the nearest station on the Kettle Valley Railway. Work was started on January 4th, 1916, since which time a wagon-road seven miles and a half long has been built; a working-shaft sunk to a depth of 150 feet; drifts driven 120 feet long on the 50-foot level, 150 feet long on the 100-foot, and 100 feet long on the 150-foot. This work was done by a syndicate of Seattle capitalists, headed by T. J. Corwin, who furnishes the information relative to the operations, and reports the shipments of copper ore approximating 1,400 tons, and as having about 3,500 tons of concentrating-ore on the dump.

A new camp with cook-house, dining-room, office, and commissary building has been erected; a compressor, a 50-horse-power steam-boiler, two pumps, and 1,200 feet of pipe-line for water-supply has also been installed.

Vernon Mining Division.

The development-work that was in progress on the *Monashee* mine, about forty-seven miles east from Vernon, during 1914 and 1915 was not continued during 1916. This was being done by the Fire Valley Gold Mining Company under the management of Dr. Elftman, a German from Minnesota, who promptly suspended work when the internment camp was established near Vernon in the summer of 1915.

Messrs. Woods, M[illegible]els, and Paul, the owners of the *Minerva* group, near Monashee, drove a t[illegible] feet long on the *Tough Nut* claim, one of the group, but on the death of M[illegible] work was suspended. The Union Hydraulic Mining Company operated on S[illegible] creek, about twenty miles west from Vernon, for about sixty days, and cleaned up about $7,000, it is reported. It is claimed that work was suspended because the operators have to construct a flume, at a cost of about $8,000, to carry the tailings from the workings across the Indian reserve to Okanagan lake.

The fact that twenty-seven mineral claims were recorded during 1916 and 102 free miners' certificates issued appears to indicate that there is a promise of greater activity in this district during 1917 than has been the case during the past season.

Kamloops Mining Division.

One of the most noticeable features in the Kamloops Mining Division during 1916 is the shipments of ore from two mineral claims in the North Thompson River district. These are about eighty miles north from Kamloops, and are known as the *Fog Horn* and *Windpass* claims, on Whistler mountain, near the head of Joseph (Boulder) creek. The properties were examined by Wm. M. Brewer, M.E., in 1915, who found them to possess considerable merit; samples taken by him assayed:—

	Gold.	Silver.	Copper.	Lead.	Zinc.	Iron.
	Oz.	Oz.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Fog Horn claim	Trace	16	6.6	16.7	16.5	17.5
Fog Horn claim	Trace	0.8	*Nil.*	78.7	4.8	....

The camp is very much handicapped because of lack of a good wagon-road from the Canadian Northern Pacific Railway, and having to travel about fifteen miles by the present route, when if a good road was built down Canyon creek the distance would be only about six or eight miles.

George Fennell, of Chu Chua, and associates own the property, and had developed it to a considerable extent previous to the completion of the Canadian Northern Pacific Railway, despite the lack of transportation. It is reported that two trial shipments were made to the Trail smelter, one from the *Fog Horn* of 52 tons, the other from the *Windpass* of 33 tons.

Further development-work was done on the *Maxine* group of mineral claims, owned by Fredericks & Phillips, of Kamloops, on Kamloops lake, about 1,600 feet from the Canadian Northern Pacific Railway. This is reported as making a satisfactory showing, and with the exceptionally good opportunity for transportation facilities, this property can be worked at a minimum cost.

The *Iron Mask* mine, on Coal hill, about six miles south from Kamloops, was operated continuously during 1916, and approximately 8,000 tons of ore was shipped and some fifty or sixty men employed. The ore from this mine usually averages about 5 per cent. copper content and low gold and silver values, judging from assays of several samplings made by Wm. M. Brewer, M.E., at various examinations made by him. This property is fully equipped throughout with electrical power, derived from the hydro-electric power plant owned by the city of Kamloops. A considerable proportion of the ore mined is concentrated in a plant with a capacity of 600 tons a day, which, it is reported, is to be improved by the addition of an oil-flotation plant, by which it is expected an increased extraction will be made. The development-work done during 1916 has been quite considerable, and with the purpose of determining the extent of the ore-bodies below the 700-foot level on the *Iron Mask*, and below the 300-foot level on the *Erin*, which are the two mineral claims that have so far been productive on a commercial scale. There are ten mineral claims included in the property, but most of the development has been confined to the two mentioned. There are many other mineral claims in the Kamloops Mining Division which have promising possibilities, but are considerably handicapped by lack of cheap transportation to the railways, as most of the claims are located from six to ten miles southerly from Kamloops; and while the wagon-roads are good, the grade of the ore is not sufficiently high to permit of wagon or auto-truck transportation.

Ashcroft Mining Division.

The Highland Valley camp has been the most active portion of the Ashcroft Mining Division during 1916, and although the *Snowstorm* group of mineral claims, which made shipments of high-grade copper ore during 1915, was not operated during the past season, the development-work done and the concentrating plant installed on the *Chataway* group marked a new era in the camp.

The Highland Valley Mining and Development Company, organized in Spokane, Washington, acquired the *Chataway* and *Tamarac* groups of mineral claims in 1915, and commenced development-work during that season. In 1916 a total of 613 feet of drifting, crosscutting, and upraising represented the development-work on the property, which was done under the management of Frederic Keffer, of Spokane. A wagon-road six miles and a half long was constructed from the mine-workings to the main Ashcroft-Merritt stage-road, one-half of the cost of which was defrayed by the Provincial Government. A concentrating-mill was installed. This is in a building with three floors; on the lowest are tanks for concentrates, an Oliver filter, and a flotation concentrating-machine, also a Root's vacuum pump for the Oliver filter, and a Fairbanks-Morse typhoon pump; on the first floor are two Robb-Mumford-Brady boilers, together 100 horse-power, one 50-horse-power engine, one Hardinge conical mill, with Challenge ore-feeder, one Union Iron Works crusher, with 9 x 16-inch jaws, one pair Reliance rolls, and an elevator to the fine ore-bins and trommel screens; on the second floor are one 35-horse-power engine, two Butchart concentrating-tables, four cone slime-tanks, one Anaconda deslimer, an 8-k.w. dynamo, a Root's blowing-engine, and a small compressor.

A typhoon pump, driven by an electric motor, is installed on a lake below the mill to pump water into three tanks, two of 12,000 gallons capacity and one of 2,000 gallons. A gravity-tramway 950 feet long connects the mine with the ore-bin at the mill.

Shipments totalling 115 tons are reported during the past summer that contained approximately 17,000 lb. of copper, or an average of about 7.3 per cent.

LILLOOET DISTRICT.

Lillooet Mining Division.

The Cadwallader Creek camp is the most important part of the Lillooet Mining Division, and an important productive lode-gold mining camp. It is by the present route, via Mission mountain, about fifty-five miles from the Pacific Great Eastern Railway, and about seventy miles from the town of Lillooet. A good auto-road connects the camp with Mission Station.

During 1916 there has been more activity on Cadwallader creek than during previous years, and the production has been larger. Three mills have been running practically continuously from early in June until November.

The *Lorne*, *Pioneer*, *Coronation*, and *Wayside* mines have each been actively operated, and the three first mentioned have produced satisfactory returns.

The *Lorne* group has been operated by A. P. Noel, of Lillooet, under a bond from the owners, the Lorne Amalgamated Mining Company. He has had about ten or twelve men at work, and has continued the main adit, which was started some years ago, until he has reached an ore-body at about 250 feet below the upper workings, from which ore was mined and treated in an arrastra in 1900. In future this adit, which is a crosscut about 400 feet long, will be the main haulage-way from the mine-workings to the 5-stamp mill, the portal of the adit being at a slightly higher elevation than the grizzly and ore-bin at the mill. The mill was operated from June until November, and was only closed down because of breaking the cam-shaft, otherwise Mr. Noel intended to attempt to continue operations during the winter and establish a record. The cost of mining and milling is reliably reported to have been as low as $4.60 a ton, and the average gold content saved from the ore somewhere about $10 a ton.

The *Coronation* mine has been worked most of the year by B. Perry under a lease from the Coronation Mining Company, but near the end of the year the company made a deal with George Aylard, the managing director of the Standard Silver Lead Mining Company, who has taken over the property and will operate it in future. The work done during the past season was principally confined to further development on the *Countless* mineral claim, one of the group contained in the property. The development-work is reported to show an increase in the width of the vein in the drift from about 8 inches to nearly 5 feet of ore that assays high in gold. An assay from the narrow part of the vein is reported by Mr. Aylard as showing 4 oz. gold to the ton.

The 10-stamp mill at the *Coronation* mine was operated only a portion of last season, treating ore from the old stopes on the *Little Joe* mineral claim of the group, also ore sorted from the old dumps, all of which is reported to have yielded fair returns, especially considering that the old plates in the mill were in very poor condition, and consequently much gold was lost in the tailings.

The Pioneer Mining Company operated the *Pioneer* mine continuously during 1916. A sawmill, run by steam-power, capacity 1,000 feet B.M.; a Lane mill, capacity about 15 tons a day; a rock-crusher; air-compressor, capacity six drills; hoist and pump, driven from the air-compressor, were installed and operated continuously from June last. The mill, compressor and rock-crusher are run by water-power, developed by a dam and flume a quarter of a mile long. An upraise was made from the old adit level to the surface and connected with a winze from the adit level sunk to a depth of 100 feet, with stations opened at 50-foot and 100-foot levels below the adit. Drifts were driven to the east and west for about 80 feet on each level and stopes opened. About 1,500 tons of ore was mined and milled during the season. The yield is reported as very satisfactory, especially from the lower west drift, the face of which is said to show a width of 5 feet of ore that was carried for several feet east from the face. The total amount of gold saved in the mill is reported, as $32,500.

The *Wayside* mine has been further developed by D. C. Paxton, the owner, who has continued driving on the No. 4 adit until its total length is 350 feet, also on the No. 6 adit to a total length of 125 feet. These adits appear to be driven on parallel veins, and a good grade of gold-bearing quartz is exposed in both. At the face of the No. 4 adit the vein is 5 feet wide and pans well.

The Golden Dream Mining Company has been prospecting the gravel-deposits on the South fork of Bridge river below the dam, and sluicing the material taken from a pit in which bed-rock was struck at 21 feet. C. P. Dam, the manager, installed an Empire drill early in the season, but owing to the boulders it was not a success. Later these operations were abandoned, and two scrapers, worked by water-power from an overshot wheel, were substituted and worked satisfactorily. About one-third of the gravel taken from the pit yielded between 35 and 40 cents to the cubic yard, saved in the sluice-boxes.

The usual assessment-work was done on those mineral claims in the camp that are not yet Crown-granted, of which there are not many, as most of the claims were staked in 1897, 1898, and 1899, and the owners acquired Crown grants some years ago.

The opening of the Pacific Great Eastern Railway has proved a great advantage to the camps in the Lillooet Mining Division, as previous to that event the district was so remote from rail transportation that the excessive freight rates retarded progress.

Molybdenite Ore.—During 1916 a shipment of molybdenite ore was made from mineral claims on Texas creek, a tributary of the Fraser river that empties into it on the west side about twenty miles south from Lillooet Station, on the Canadian Northern Pacific Railway. The shipment contained 9 tons of molybdenite which carried 16 per cent. molybdenite. The operators of this property are greatly handicapped because of remoteness from transportation and rough trail from the claims to the Lillooet wagon-road.

Talc.—Two cars of talc were shipped during 1916 from near the shore of Anderson lake, near the mouth of McGillivray creek.

COAST DISTRICT.

Vancouver Mining Division.

The most important mining operations in this Division are those carried on by the Britannia Mining and Smelting Company, Limited, at Britannia Beach. An interesting article on the *Britannia* mine and concentrating-mill recently appeared in the *Mining and Scientific Press*, written by the editor, T. A. Rickard, who designates this mine as "the biggest copper-mine in the British Empire." The area of the Britannia Company's property in the mountains above Howe Sound is now approximately 20,000 acres. Two towns are maintained and owned by the company, one at the Beach, where the concentrating-mill is situated, and the other up at the mine. From 1,200 to 1,300 men are employed, and at the time of Mr. Rickard's visit twenty different nationalities were represented on the pay-roll.

The production of the company for the year 1916 is expected to have been about 421,000 tons, containing 836 oz. gold, 98,000 oz. silver, and 18,000,000 lb. copper. This shows an increase of 207,850 tons over the production of 1915. Milling facilities have been increased during the year, and it is expected that in the future the mine will steadily increase its yearly production.

The reserves of reasonably assured ore are said now to total 17,000,000 tons, carrying about 2½ per cent. copper and 25 cents in silver to the ton. Mr. Rickard describes the ore-bodies as follows: "It is not a single vein, nor even a series of them, but a big width of schist enriched by seams of chalcopyrite. As yet, eleven veins have been labelled in a belt 800 feet wide; the average stoping width of each vein is put at 30 feet, and the maximum at 80 feet; but such measurements are only suggestive; the actual width of ground to be stoped is yet to be determined by further operations. In length the separate ore-bodies have been proved for 1,000 feet, and in depth for 1,600 feet. The chalcopyrite is confined mainly to fissured channels in a silicified sericitic schist, adjacent to a dioritic porphyry. Near the ore the schist is spotted with chlorite. Any rock broken in the course of exploratory work is sent to the mill if it contains ½ per cent. copper."

The ore on being sent to the mill is sorted on a picking-belt, where crude solid ore and waste are picked out; the crude ore represents about one-tenth of the entire mill output. The next mill treatment is a water-concentration by means of jigs and tables, and finally the tailings are treated in the Minerals Separation process oil-flotation plant.

A composite analysis of the mill-feed in September showed 2.74 per cent. copper, 7.95 per cent. iron, 1.5 per cent. zinc, 6 per cent. sulphur, 71.25 per cent. silica, besides a trace of gold and 25 cents to the ton in silver. The concentrates as shipped to Tacoma smelter average from 15 to 16 per cent. copper.

Other properties worked in this Division during the year were those of the Rowena Copper Mines, and some others. No detail information has as yet been received regarding these properties.

New Westminster Mining Division.

Very little productive mining is as yet being done in this Division, but it is pleasing to report that a number of claims situated on Anaconda, Alexander, and Kennedy mountains, in the vicinity of Pitt lake, have been bonded to an American syndicate, and it is expected that active development will be undertaken during the coming summer.

There were fewer free miners' certificates issued and fewer new claims recorded on account of so many of the active men being absent at the war, but it is interesting to note that the number of assessments recorded during the year is about 25 per cent. greater than the preceding year, indicating a more serious interest in active development.

As yet the only shipment of ore from the Division to be recorded was 160 tons from the *Viking* claim, near Pitt lake.

Vancouver Island.

During 1916 there has been more activity displayed in the metalliferous-mining industry on Vancouver Island than for several years. Several mining engineers and other representatives of capital have been scouting through the mineral-bearing districts, examining and in some cases bonding properties, many of which have been idle for years.

Serious prospecting and development work has been done on the west coast of Vancouver Island on the following properties: *Old Sport*, *Yreka*, and *June* groups of mineral claims, on Quatsino sound; also on the *Indian Chief* group, on Sidney inlet; on the *Ormond* group, on Flores island; on the *Jumbo* and *Crow* mineral claims, on Deer Creek, at the head of Tofino inlet; on the *Monitor*, on Alberni canal; and on the *Torsc* group, on Snug basin, Uchucklesit harbour.

At East Sooke the *Willow Grouse* group of mineral claims has been worked and shipments of copper ore made to the Tacoma smelter.

A shipment of 400 tons of copper ore was made from the *Indian Chief* and a shipment of 46 tons from the *Monitor*.

The *Old Sport* group of mineral claims was acquired by a company subsidiary to the Consolidated Mining and Smelting Company of Trail, and further development-work commenced on September 1st under the superintendence of William Clancy, who had previously prospected the property for the Quatsino Copper Company with diamond-drill, long crosscut adit, and trenches every 50 feet, for a total length of 3,000 feet along the strike of the ore-body.

The *Yreka* and *June* groups were further prospected and developed by N. A. Clark and associates, who secured bonds on both groups, and were late in the fall preparing to install a wharf and bunkers at the *Yreka* preparatory to commencing shipments.

The *Indian Chief* group was acquired by Sam Silverman, of Seattle, and associates during the fall; work started by cleaning out the old workings and doing further prospecting, also stoping on an ore-body that had been overlooked by the lessees when the property was being operated in 1909 and 1910. The first shipment from this, of 400 tons, was made to the Tacoma smelter in December.

The *Ormond* group, on Flores island, Clayoquot sound, was acquired by H. W. E. Canavan, of Victoria, in June last, when further prospecting was done and the property capitalized in a joint-stock company.

The *Jumbo* and *Crow* mineral claims were acquired during the spring by Sam Silverman, of Seattle, and associates, who have kept a force of miners at work developing the ore-bodies beyond the point where work was suspended several years ago.

The *Monitor* group, which produced about $70,000 from copper ore shipped in 1900 and 1901 to the Tacoma smelter, and had been sold for taxes about three years ago, when it was bought in by Leonard Frank, of Alberni, was leased to James L. Skene. Further prospecting developed new ore-bodies, which were opened up, and the first shipment made in December to the Trail smelter.

Considerable prospecting was done on the *Torse* group, on Snug basin, but work was closed down in the fall.

The mineral resources of Vancouver and adjacent islands were fully examined during 1916 by Wm. M. Brewer, M.E., of Victoria, who is preparing separate detailed reports, one dealing with the iron ores and another with the copper-gold-silver ores. These will be published as soon as practicable.

The *Big Interior* group of mineral claims, near the head of Drinkwater river, that flows into the north end of Great Central lake, in the Alberni Mining Division, was bonded late in the fall of 1916. It was examined by Alex. Sharp, M.E., of Vancouver, in the beginning of October, and as a result the owners, Joe Drinkwater and M. Tebold, executed a bond to his clients, who are reported to be Foley, Welch & Stewart. The purchase price is said to approximate $50,000. A diamond-drill, gasolene-engine, and several tons of supplies were shipped to Alberni shortly after Mr. Sharp's return from the property to Vancouver, and immediately on arrival this equipment and supplies were transported to the river camp at the foot of Della falls, near the claims, in order to be ready for operations as early in the spring as it is possible to begin work. The claims are at an elevation of about 6,200 feet above sea-level, and on the watershed of Buttle lake towards the north, Great Central lake towards the east, and Bear river towards the west.

Texada Island.

During 1916 the *Marble Bay* was worked continuously and shipments of copper ore amounting to about 13,000 tons were made to the Tacoma smelter. Much prospecting was done with diamond-drill on the 1,500-foot level, and between that level and the 1,300, in order to locate the extension of the ore-body that was stoped from between the 1,200 and 1,300 levels. The *Copper Queen* and *Little Billie* mines were worked by leasers, who shipped some 1,400 tons of ore from the old workings. The property of the Puget Sound Iron Company on the west coast of the

Island was leased during 1916 by G. J. Hammond, of Vancouver, who erected a wharf and bunkers preparatory to making shipments of ore carrying sufficient copper content to be of commercial value as such.

Quadra Island.

The *Santa Anna* group, near Bold point, on the east side of Quadra, the southernmost of the Valdes Islands, was the scene of prospecting-work with diamond-drill in the interests of H. W. Treat, of Seattle, and the Granby Consolidated Mining, Smelting, and Power Company. The work was done on the properties near Gowland harbour, but the results were not made public.

PROFITS OF MINING COMPANIES.

The following statement shows the dividends declared by operating metalliferous-mining companies during the calendar years 1913, 1914, 1915, and 1916:—

Name of Company.	1913.	1914.	1915.	1916.
British Columbia Copper Co., Greenwood	$ 88,756	......	......	.....
Consolidated Mining and Smelting Company, Trail	348,264	$464,376	$493,425	$941,050
Granby Con. Mining, Smelting, and Power Co., Grand Forks	899,911	449,955	449,955	1,049,896
Hedley Gold Mining Co., Hedley	360,000	300,000	300,000	240,000
Le Roi No. 2, Ltd., Rossland	43,830	...	58,440	......
Rambler-Cariboo Mines, Ltd, Three Forks	....	.....	35,000	70,000
Standard Silver-Lead Mining Co., Silverton	650,000	475,000	250,000	600,000
Totals	$2,390,761	$16,89,331	$1,586,820	$2,800,946

The amount of $2,800,946 shown above as distributed profits for the year 1916 by no means represents the total of net profits earned during that year. A glance at the published accounts of several of the companies for their respective last fiscal years will make it clear that in these several instances there was as well a substantial sum placed to the credit of Profit and Loss Account.

While little information is published usually relative to the earnings of coal-mining companies operating in the Province, it is known that in the case of the Crow's Nest Pass Coal Company, if not in other instances, fairly satisfactory headway has been made in recent years. The following statement, for which the president of the company was quoted as authority, was published lately: During the last three years the Crow's Nest Pass Coal Company has paid off all its bills and accounts payable, amounting in 1912 to a total of $1,081,690. The liability on these accounts was reduced to $811,605 in 1913, to $498,241 in 1914, and the balance was entirely cleared off in 1915.

During the year 1916 the company is reported to have paid dividends to the amount of $372,756.

The total amount thus paid by mining companies in the Province during the year 1916, as far as known, was $3,173,702, or about double of the preceding year.

Generally, it may be said that the outlook for the larger operating mining companies of British Columbia is more promising than at the beginning of several successive late years. There is good demand for the metals they produce, prices are higher than at this time last year, operating conditions are favourable to a larger production, and there is no present prospect of any set-back to interfere with the progress that it is now confidently expected will be made in 1917.

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